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Teachers' Beliefs, Barriers, and Classroom Practices: A Mixed Methods Study of Technology Integration at a School for Students with Dyslexia

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Conducting research in a school setting during COVID-19 was a challenging endeavor, and I am thankful for the six teachers who took part in the qualitative phase. They welcomed me into their virtual classrooms even as they were navigating a new learning environment and graciously agreed to an additional round of interviews that extended into the following school year. Their flexibility and commitment to this research project was inspirational.

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ABSTRACT

The purpose of this action research was to describe teachers' beliefs about technology in the classroom and identify the barriers they faced when integrating technology at a small, private school for students with dyslexia. The amount of technology available in schools has increased steadily over the past two decades. Additionally, online learning has become a viable option for K-12 students, and the novel Coronavirus forced many teachers and students into this environment during the 2020 school year. Despite increased access to technology, higher-level uses have not followed, and many teachers at the school continue to struggle integrating technology in their classrooms. This research focused on three research questions in an effort to understand how teachers' beliefs may be affecting technology integration at the school. The first question sought to describe new online teachers' beliefs about the role of technology in teaching and learning. The second question identified the barriers teachers perceived to hinder technology integration. Finally, the third research question explored whether or not teachers' classroom practices were in alignment with their stated beliefs.

This study followed a mixed methods design to address the research questions. Quantitative data was collected through a survey administered to all 55 teachers at the school in order to gain descriptive information about how technology was being used throughout the school. From this sample, six participants were selected for follow-up interviews. Participants were identified as either experienced technology integrators, intermediate technology integrators, or novice technology integrators. Qualitative data was collected from these participants through three interviews and two classroom observations in order to provide additional descriptive data to answer the research questions. Quantitative data revealed more teacher-centered beliefs and practices of teachers at the school. However, qualitative findings showed teachers with more student-centered beliefs integrated technology more in their classrooms. Findings also revealed external factors, namely the school culture and distance learning, influenced teachers' beliefs about the role of technology. Barriers to technology integration were identified by all participants. First-order barriers identified included time, access, and co-teacher's beliefs. Only novice integrators and one intermediate integrator experienced second-order barriers, specifically lack of technological knowledge and teacher's beliefs. Implications from this study include providing professional development adapted to teachers' levels of technology integration. Additionally, steps to reduce first-order barriers identified in the study are suggested.

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CHAPTER 1

INTRODUCTION

National Context

The past three decades have seen a tremendous increase in the technology available in schools. In 1995 only 8% of public schools contained a computer with Internet access for instructional purposes, yet that number had increased to 98% by 2008 (U.S. Department of Education, 2016). In addition to increased technology within schools, school districts have begun leveraging technology to provide online learning opportunities for K-12 students (Digital Learning Collaborative, 2019). The question is no longer whether technology should be used in schools, but how it can be used to enhance learning. The National Education Technology Plan (NETP) specifies technology should be used to provide transformative learning experiences that equip students with 21st century skills to be competitive and engaged participants in a global society (U.S. Department of Education, 2017). Despite this vision, many schools are not using technology in ways that enhance learning (Ertmer, Ottenbreit-Leftwich, & Tondeur, 2015; Hsu, 2016; Kim, Kim, Lee, Spector, & DeMeester, 2013; U.S. Department of Education, 2017).

Research has shown that using technology in student-centered ways can produce positive impacts on performance (Lei & Zhao, 2007; Machin, McNally, & Silva, 2007). Hsu (2016) notes, “Higher-level technology use will enhance every aspect of students’ learning experiences across curricular areas, so students will grow intellectually rather than merely develop isolated technology skills" (p. 30). However, historically teachers have used technology tools to sustain already established teaching practices (Cuban, Kirkpatrick, & Peck, 2001; Ertmer & Ottenbreit-Leftwich, 2010; Palak & Walls, 2009). A national survey conducted in 2009 found teachers' most common uses of technology in the classroom were word processing tasks, managing student records, and making presentations (Gray, Thomas, & Lewis, 2010). Recent research supports this trend of low-level uses of technology for instruction, such as drill and practice activities or displaying information (Hsu, 2012; Levin & Wadmany, 2008; Pittman & Gaines, 2015; Wachira & Keengwe, 2010). Even teachers in online learning environments have been found to assign students seat work for asynchronous assignments that practice knowledge or skills presented during the lesson (Barbour, 2012). Despite the increases in technology available to teachers and students, it is not being fully integrated into classrooms for learner-centered, high-level uses (An & Reigeluth, 2011; Hsu, 2016; Palak & Walls, 2009).

Previous research has identified multiple barriers that exist to inhibit successful technology integration (Blackwell, Lauricella, Wartella, Robb, & Schomburg, 2013; Ertmer, 1999; Francom, 2016; Hew & Brush, 2007; Pittman & Gaines, 2015; Wachira & Keengwe, 2010). Common barriers identified include access to technology, lack of knowledge and skills relating to technology, time to plan and implement technology-rich lessons, and teachers' beliefs about the importance of technology use for learning (Ertmer, 1999; Hew & Brush, 2007; Kopcha, 2012). Researchers have separated these barriers into two categories: first-order and second-order barriers (Blackwell et al., 2013; Ertmer, 1999; Wachira & Keengwe, 2010). First-order barriers consist of more extrinsic resources, such as lack of access to technology, lack of time to plan or implement, and inadequate technical support (Blackwell et al., 2013; Ertmer, 1999; Makki, O'Neal, Cotten, & Rikard, 2018; Wachira & Keengwe, 2010). However, second-order barriers are those more intrinsic to teachers and address teaching beliefs, beliefs about computers, established classroom practices, and unwillingness to change (Blackwell et al., 2013; Ertmer, 1999; Makki et al., 2018; Wachira & Keengwe, 2010).

As technology has become more available in schools, it appears second order barriers play a significant role in technology integration. Several studies have found that teachers' beliefs about technology use in the classroom are one of the strongest barriers to integration (Blackwell et al., 2013; Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, & Sendurur, 2012; Miranda & Russell, 2012; Walker & Shepard, 2011). In fact, Ertmer (1999) suggests teachers' beliefs may affect their ability to overcome other barriers due to the relative weight they place on each barrier. Additionally, second-order barriers are more difficult to change and require teachers to redefine what teaching means to them (Ertmer, 2005; Ertmer et al., 2015). When teachers perceive technology to have value in the teaching and learning process, they are more likely to use it (Hsu, 2016; Mama & Hennessy, 2013; Miranda & Russell, 2012; Sadaf & Johnson, 2017; Taimalu & Luik, 2019). Furthermore, researchers have found a connection between constructivist teaching beliefs and technology use (Hermans, Tondeur, van Braak, & Valcke, 2008; Hsu, 2016; Kim et al., 2013; Tondeur, van Braak, Ertmer, & Ottenbreit-Leftwich, 2017). Teachers who possessed more learner-centered beliefs about teaching were found to have more seamless integration of technology into lessons (Kim et al., 2013).

Teacher beliefs are complex. There is some research to support teachers' espoused beliefs aligning with their classroom practices (Deng, Chai, Tsai, & Lee, 2013; Ertmer et al., 2012; Hsu, 2016; Kim et al., 2013). Therefore, exploring the beliefs that underlie classroom practices can bring about the change necessary to enhance student learning through transformative, technology-rich lessons. Several researchers cite the need to understand teachers' beliefs as a necessary step in integrating technology effectively (e.g., Ertmer & Ottenbreit-Leftwich, 2010; Ertmer & Ottenbreit-Leftwich, 2013; Ottenbreit-Leftwich, Glazewski, Newby, & Ertmer, 2010; Tondeur et al., 2017). Recognizing the beliefs teachers hold about teaching and learning, the barriers they face to integration, and the support they need is the first step in designing effective professional development (An & Reigeluth, 2011; Ertmer et al., 2012; Ottenbreit-Leftwich et al., 2010). Once these beliefs are understood, training can be aligned with those beliefs to provide the skills necessary to integrate technology for student-centered learning (An & Reigeluth, 2011; Ertmer et al., 2012; Ottenbreit-Leftwich et al., 2010).

Local Context

This action research study was conducted at a small, private school in the southeastern United States. The school offers a specialized phonics-based instructional approach for reading remediation to students who have been diagnosed with dyslexia. The total student population is 250 students organized into 25 classes between kindergarten and sixth grade. Despite its small size, the school provides teachers and students with ample technology. Every classroom is equipped with an interactive display, and all teachers have a laptop computer provided by the school for their use. Student to tablet computer ratios for kindergarten through third grade are one to one while students in fourth, fifth, and sixth grade share tablet computers with another student. Additionally, every student in fourth, fifth, and sixth grade is issued a laptop computer. Third grade students have access to two laptop computer carts that are shared among the grade. Devices are loaded with numerous apps and software for learning in addition to providing access to the school's Google G-Suite account. Despite the abundance of technology resources, data from a technology assessment and online survey administered through Google Forms revealed teachers are using the devices for low-level tasks, such as presentations and drill and practice activities.

In 2014, a technology assessment was conducted by Educational Collaborators, a national consulting firm specializing in developing technology plans and programs for schools. Information was collected through focus group interviews with teachers, students, parents, and administrators. Findings regarding academics noted, "The faculty need support in developing their individual toolkits, both software and pedagogy" (Educational Collaborators, 2014, p. 18). Recommendations included acquiring more devices for student use and providing professional development related to technology for faculty (Educational Collaborators, 2014). Additionally, the use of a model such as SAMR was suggested where teachers progress in their technology integration by looking for ways to substitute, augment, modify, and redefine the curriculum (Educational Collaborators, 2014). Furthermore, the report specifically noted teachers should be encouraged to use technology for project-based learning units and discouraged from using devices for rewards or free-time entertainment (Educational Collaborators, 2014).

Following this report, several recommendations were put in place. Additional tablet computers and laptop computers were acquired to increase the ratio of one student to one device in every grade. Professional development was addressed through several measures. During the summer of 2015, all teachers participated in an online course created by two faculty members with training in instructional technology. The course provided research articles, supporting materials, and examples of best practices in instructional technology. Teachers responded to the readings in a blog format, so they were exposed to using technology for higher-level learning, as well as a tool for collaborating with peers. This was followed by a three-month long training focused on project-based learning units for classroom implementation. Additional workshops have been provided to faculty covering the use of Google apps, such as for teacher productivity, student collaboration, student products, and teacher collaboration. Despite these efforts, more recent survey data collected for the school's strategic plan do not show significant impact on teachers' technology uses in their classrooms.

The school released a five-year strategic plan in 2016 with integrating technology as one of the goals. The purpose of this goal was "to design a plan for integrated technology instruction at [the school] that is mission-driven, intentional, and responsive to our students' unique needs." A survey shared with the faculty in order to collect data for the strategic plan asked several questions regarding teachers' use of technology for instruction. In response to the question "How do you use technology for instruction?" the most frequently reported use (51%) was to display information. Additionally, many of the uses identified by teachers (50%) fell under the category of drill and practice activities. These included the apps Hearbuilder and IXL, as well as the use of Smart Lab games played on either the classroom's interactive display or student tablet computers. Both of these uses for technology, to display information and drill and practice activities, were frequently combined in responses from individuals, as evident in statements such as "[I use the] Smartboard (mostly as a whiteboard), games, instruction". Only four respondents (0.08%) mentioned student-centered uses of technology that revolved around creating products. When asked to identify the biggest obstacles regarding technology use, teachers' responses included many of the common barriers cited in the literature, including time, support, training, and beliefs. A lack of knowledge in how to use technology to enhance instruction was frequently cited as an obstacle, such as when one teacher said, "[I want to know] how to integrate technology with current lessons. I don't want to just use tech to use it."

Data revealed the majority of teachers at the school were not using the technology resources available for student-centered learning. In addition to teacher-centered uses of technology, teachers had minimal knowledge of teaching in an online environment. Only one teacher had received her teaching endorsement in online education. As with many educational institutions in 2020, the school transitioned to distance learning due to the COVID-19 pandemic. Teachers were required to quickly shift from in-person instruction to online instruction within a short period of time. Distance learning required teachers to integrate technology in order to reach their students.

As researchers have cited, understanding teachers' beliefs is a crucial step to effectively integrating technology (Ertmer & Ottenbreit-Leftwich, 2010; Ertmer & Ottenbreit-Leftwich, 2013; Ottenbreit-Leftwich et al., 2010; Tondeur et al., 2017). How teachers view the role of technology in teaching and learning, as well as the value it could bring to their classrooms, affects their teaching practices (Ertmer et al., 2012; Ertmer &

Ottenbreit-Leftwich, 2010). Therefore, in order to enact change regarding the use of technology to enhance learning, teachers' underlying beliefs must be understood.

Statement of the Problem

Teachers at a school for students with dyslexia do not effectively integrate technology into instruction for student-centered learning.

Significance of the Problem

K-12 classrooms across the country have seen increases in the technology available to students. However, the increase in technology available has created a discrepancy between access and use. Technology is frequently not being used for higher-level, student-centered instructional purposes (An & Reigeluth, 2011; Hsu, 2016). Teachers at the school exhibited this discord between access and use. While all classrooms have access to technology in ratios of one student to one device, data revealed technology continued to be used for teacher-centered, low-level learning tasks. Researchers have identified common barriers to technology integration, namely access to technology, support for technology use, teachers' beliefs about the role of technology in learning, time to plan and implement technology rich lessons, and professional development focused on technology skills as well as actual classroom application of technology (Blackwell et al., 2013; Ertmer, 1999; Hew & Brush, 2007; Wachira & Keengwe, 2010). Recent school surveys indicated that teachers experienced many of these same barriers to integration. Several studies have found that of the obstacles teachers encounter, teachers' beliefs about technology use in the classroom are one of the strongest barriers to integration (Blackwell et al., 2013; Ertmer et al., 2012; Wachira & Keengwe, 2010; Walker & Shepard, 2011). Ertmer (2005) argued a change in one's beliefs is risky and more difficult to achieve because it fundamentally changes what one thinks and these changes are often irreversible. However, understanding teachers' beliefs about technology use in the classroom can facilitate the development of effective support in order for teachers to successfully integrate technology (Ertmer, 2005).

Purpose Statement

The purpose of this action research was to describe teachers' beliefs about technology integration at a school for students with dyslexia.

Research Questions

This action research study addressed the following research questions:

1. What are new online teachers' beliefs about the role of technology in teaching and learning at a school for students with dyslexia?
2. What are new online teachers' perceived barriers to technology integration at a school for students with dyslexia?
3. How do new online teachers' observed classroom practices align with their stated beliefs about technology?

Researcher Subjectivities and Positionality

As an educator who works in a school focused on continuous improvement, I was motivated to pursue a doctoral degree in order to become an educational technology leader and change agent within my organization. Furthermore, I wanted to better understand the action research process and how systematic investigation of problems could promote positive change. Educational technology leaders are knowledgeable and skilled in both the tools and instructional methods for integrating technology. They model effective uses of technology for instruction and continue to explore new methods and tools. Educational technology leaders recognize that technology adoption is a complex process requiring patient guidance for those who are apprehensive of change.

My path to become an educational technology leader began in the classroom as a fifth-grade teacher. On a personal level, I experienced increased productivity brought about by technology tools. I wanted to explore new tools and find easier, more efficient ways of completing tasks. On a professional level, I witnessed students use applications to create products that showcased their individuality and creativity. They were able to use these tools to express themselves in ways they were not able to before, such as creating screencasts to explain a solution to a math problem or using a coding program to create a story. Not only did I see students' creativity blossom, but I realized the power of letting students take charge of their learning. I recognized a change in my role from being the one who departed knowledge to being a facilitator as they constructed knowledge. Seeking to better understand how to make this shift in teaching and ensure I was using technology in ways that aligned with research-based practices, I returned to graduate school to study instructional technology. After completing my degree, I transitioned from a classroom teacher to the instructional technology specialist at my school. This role allowed me to work with all students and teachers to build technological knowledge and skills in addition to integrating technology into the classroom. After serving in this role for three years, I moved into administration as the curriculum and instruction technology coordinator. Within this position, I have continued to work with teachers but also look for new ways to integrate technology to improve instruction.

My experiences with technology brought about an evolution in my pedagogical beliefs, as well as my beliefs about the value technology holds for teaching and learning.

These beliefs have led me to continuously seek new ways to engage students and enhance their learning. However, not all teachers share these beliefs. In fact, teachers' beliefs can act as a barrier to technology integration (Ertmer et al.2012; Hsu, 2016; Mama & Hennessy, 2013; Miranda & Russell, 2012). Therefore, understanding teachers' beliefs is a necessary step to achieving successful technology integration. Through my research, I was interested in understanding the perceptions other teachers at my school hold about technology use in teaching and learning. Understanding teachers' views regarding technology provided direction to create action steps toward successful integration.

My research was framed in a pragmatic paradigm. Pragmatists focus on finding solutions to the research problems using all approaches available (Creswell, 2014). Furthermore, researchers following a pragmatic paradigm recognize that individuals have their own unique interpretation of reality (Mertens, 2009). A mixed methodology aligns with the pragmatic paradigm because it utilizes different methods matched to specific research questions (Mertens, 2009). Through survey data, I was able to collect information about participants' beliefs regarding the importance of technology in teaching and learning, how they were using technology in their classrooms, and barriers they faced when integrating technology. Interviews and classroom observations allowed me to build rich descriptions of the context and participants' perceptions toward technology use in the classroom.

A key principle of action research is the degree to which the researcher is positioned within the community under study (Merriam & Tisdell, 2016). My position was that of an insider (Herr & Anderson, 2005) who engaged with other insiders to understand the effect teachers' beliefs had on technology integration. The sixteen years I have taught at the school cemented my insider status. I have developed rapport with the teachers, and while no longer a classroom teacher, I am viewed as one of them. As a Caucasian female, I am among the majority population of teachers at my school. For these reasons, I can relate to many of the experiences teachers encounter through their personal and professional lives. These shared experiences aided my research by creating mutual respect for each other.

Through my insider status I have developed trust among the other teachers, and this benefited my research. However, the knowledge and experiences that made me an insider also created challenges to my research. My enthusiasm for technology has led me to my current position, and not all teachers related to my desire to pursue educational technology or to leave the classroom. Due to my current role as an administrator focused on instructional technology, some teachers felt uncomfortable sharing negative beliefs toward technology with me. To mitigate these concerns, I reminded teachers that the purpose of this research was to understand their views and perceptions; there were no right or wrong answers to interview questions. Carefully selecting interview locations, respecting participant's time, and asking questions that allow the participant to talk freely helped build trust. Another challenge of my position was that teachers may have felt classroom observations were an opportunity to evaluate their use of technology. Teachers were reminded that the purpose of classroom observations was only to collect data.

As the curriculum and instruction technology coordinator, I hold strong beliefs about the value of technology in the classroom. My background and prior experiences create biases that shaped how I interpret my findings; such is the nature of qualitative research (Creswell, 2014). By being aware of these biases, I was able to regularly check myself through the process of bracketing. Bracketing involves continuous, reflexive examination of my interpretations to determine if I am imposing my own assumptions on the data (Fischer, 2009). Understanding the assumptions I bring to the research allowed my understanding of the data to evolve by re-examining my interpretations in relation to emerging ideas (Fischer, 2009). Finally, an awareness of my biases helped when reporting results and share findings by avoiding misrepresentations.

Definition of Terms

Barriers to Technology Integration

In this research study, barriers to technology integration are defined as obstacles that prevent meaningful technology use in the classroom (Ertmer, 1999).

Distance Learning

For the purpose of this research, distance learning is defined as remote online education employed by schools in response to the COVID-19 pandemic (Greenhow, Lewin, & Staudt Willet, 2020).

Online Learning

In this research study, online learning is defined as education that is delivered primarily over the Internet (International Association for K-12 Online Learning, 2011).

Teacher Beliefs

For the purpose of this research, teacher beliefs encompass teachers' value beliefs, pedagogical beliefs, and self-efficacy. Teacher beliefs will be defined as the beliefs teachers hold about teaching and learning, their beliefs about the value of technology for teaching and learning, and their confidence in their abilities to use technology for instruction (Ertmer, 2005; Ertmer & Ottenbreit-Leftwich, 2010; Taimalu & Luik, 2019; Tondeur, et al., 2017).

Technology

In this research study, technology is broadly defined as the hardware, such as laptop computers, tablet computers, and interactive whiteboards, as well as related software, and the Internet used for student learning (Hew & Brush, 2007; Hsu, 2016).

Technology Integration

For this research, technology integration is defined as technology used in the classroom for the purpose of creating meaningful learning through the application of skills to collaborate, communicate, problem solve, and achieve authentic, complex goals (Ertmer, 1999; Ertmer & Ottenbreit-Leftwich, 2010; Ertmer et al., 2012).

CHAPTER 2

LITERATURE REVIEW

The purpose of this action research was to describe teachers' beliefs about technology integration at a private school for students with dyslexia. Specifically, this research sought (a) to describe new online teachers' beliefs about the role of technology in teaching and learning, (b) to identify the perceived barriers that hinder technology integration, and (c) to observe teacher practices to identify whether or not these are in alignment with teachers' stated beliefs.

Four key variables guided the literature search to identify current, relevant literature related to the research questions. Those key variables were: (a) technology integration, (b) barriers to technology integration, (c) teachers' beliefs, and (d) classroom practices. Initial searches through the University of South Carolina (USC) library system utilized several academic databases, namely *ERIC*, *JSTOR*, *ScienceDirect*, *Computer Source*, and *Education Source.* A variety of search terms were used during multiple searches and included combinations of the following terms: technology integration, technology implementation, barriers, beliefs, views, attitudes, perceptions, classroom use, classroom practices, K-12, TPACK, SAMR, technology integration models, teacher pedagogical beliefs, online learning, theory of planned behavior, and technology acceptance model. Results were limited to peer-reviewed, full-text articles published between 2013 and 2021. Later searches expanded this range to include articles published as early as 2011. Bibliographic references provided in articles were also used to identify relevant research and seminal works on topics related to my research. Some of these works were searched by title and author through the USC library. *Google Scholar* was utilized to find specific works of literature that could not be found through the university library, and several book chapters were located using this method.

The review of the literature that follows is divided into three main sections. The first section describes technology integration in terms of varying definitions, the role of technology in teaching, online learning, and models used to describe effective integration. The second section examines factors that enable technology integration or serve as barriers to integration. The third section focuses on teachers' beliefs, identifying the characteristics of teachers' beliefs, how beliefs can act as barriers to technology integration, and alignment of teachers' beliefs and their classroom practices.

Technology Integration

The past three decades have been marked by rapid advances in technology that have permeated school systems. Primary and secondary schools have experienced significant increases in the amount of technology available with most schools now striving for a one device per one student ratio (Delgado, Wardlow, O'Malley, & McKnight, 2017). Online learning has been introduced in K-12 environments and seen steady increases in enrollment over the past 20 years (Greer, Rowland, & Smith, 2019). The increase in technology within face-to-face and virtual classrooms necessitates understanding effective technology integration. This section (a) addresses the conflicting definitions of technology integration, (b) examines classroom use, (c) describes online learning in K-12 education, and (d) presents a theoretical framework for technology integration.

Definition of Technology Integration

Accurately defining technology integration is crucial to understand what is involved in the process of integration and to identify when successful integration has occurred. Characteristics of effective integration include technology use that is seamless, intentional, and meaningful while allowing students to focus on learning (Cifuentes, Maxwell, & Bulu, 2011). Quality technology integration helps teachers meet learning goals that they would not be able to accomplish otherwise (Cifuentes et al., 2011). Despite recognizing these requirements for effective integration, consensus around a definition of technology integration does not exist in the literature. Often, researchers create their own definitions, which vary in scope and emphasis. For example, An and Reigeluth (2011) broadly defined technology integration as "the use of technology for instructional purposes" (p. 55). Such a general definition lacks specificity and does not convey the importance of technology use to meet learning goals.

Other definitions encapsulate the uses of technology at the expense of the learning outcomes. For example, Inan and Lowther's (2010) definition of integration includes the use of technology "for instructional preparation" and "instructional delivery" (p. 138). Identifying the ways technology may be used by teachers to prepare materials does not prioritize using technology as part of an instructional strategy. Furthermore, the use of technology to deliver instruction emphasizes teacher-centered pedagogical methods which may deprive students of the opportunity to use technology in new, complex ways.

Some researchers have successfully created definitions that incorporate a focus on learning goals while using technology as a way to improve student achievement of those goals. Ertmer's (1999) early definition of technology integration is perhaps the most accurate and stands the test of time. She describes technology integration as a process where "technology adds value to the curriculum not by affecting quantitative changes (doing more of the same in less time) but by facilitating qualitative ones (accomplishing more authentic and complex goals)" (Ertmer, 1999, p. 49). Her definition emphasizes the use of technology to accomplish learning objectives while also recognizing that technology has the capacity to transform learning by providing authentic, meaningful learning tasks.

Role of Technology in the Classroom

Technological advancements have coincided with changes in educational models. Determining best practices for utilizing educational technology to support student learning requires understanding its role in contemporary educational models. Educational reform initiated in the late 1990s emphasized incorporating student-centered psychological principles into the classroom in order to meet student needs (American Psychological Association Work Group, 1997). Some hallmarks of student-centered classrooms include personalized and customized learning, teachers acting as facilitators who allow students to construct knowledge, and authentic learning experiences to help students develop real-world skills (An & Reigeluth, 2011). Technology provides ample opportunities for students to construct knowledge and develop the skills necessary to participate in an ever-increasing global society. However, if technology is going to provide meaningful, authentic learning experiences, a pedagogical shift must occur (Ertmer & Ottenbreit-Leftwich, 2012). Rather than teachers imparting knowledge to students as passive learners, students must become active and engaged in their learning. The following paragraphs synthesize research regarding (a) how technology is being used in K-12 settings and which uses provide meaningful, authentic learning experiences for students, (b) the motivations of teachers to use technology, and (c) the effectiveness of technology use in the classroom.

Technology use in K-12 settings. Despite the substantial increase in access to technology within schools, an increase in use and more substantive uses have not followed. As early as 2001, research into how teachers were using technology revealed they were not altering their existing practices (Cuban, Kirkpatrick, & Peck, 2001). More current research indicates that teachers continue to utilize technology in traditional ways (Palak & Walls, 2009). Frequently cited uses of technology by teachers involve word processing tasks (Dawson, 2012; Delgado et al., 2017; Polly & Rock, 2016; Vannatta & Fordham, 2004). Additional uses include email and Internet (Vannatta & Fordham, 2004) as well as spreadsheet and presentation programs and multimedia (Gu, Zhu, & Guo, 2013; Ruggiero & Mong, 2017). A recent study focusing specifically on interactive whiteboard technology found teachers used the boards for presenting material to the class, displaying websites, and in place of blackboards (Karsenti, 2016). Teachers continue to use technology in ways that support their professional needs, but they are not using technology as an instructional tool for learning (Ertmer & Ottenbreit-Leftwich, 2010).

In addition to traditional uses of technology, most teachers employ a teacher-centered pedagogical approach (Dawson, 2012; Palak & Walls, 2009). In such an approach, teachers impart knowledge to students who passively receive information. For illustrative purposes, Dawson (2012) found that teachers used technology 43% of the time for direct instruction, and 38% of the time for collaborative learning. Similarly, Polly and Rock (2016) noted that teachers used technology 65% of the time while students only used it 35% of the time. Moreover, when teachers are using technology, the tasks tend to tap low-level thinking skills, such as remembering, more than high-level skills, such as evaluating (Dawson, 2012; Polly & Rock, 2016; Ruggiero & Mong, 2017). For example, a study of teacher candidates' lesson plans integrating technology revealed most technology uses focused on basic skills (Polly & Rock, 2016). Offering a defense for these types of uses of technology, practicing teachers reported feeling the curriculum mandated teacher-centered practices (Orlando, 2013). Using technology for low-level tasks, such as drill and practice activities, provides students with repetition. However, high-level tasks utilizing technology could provide opportunities for students to engage and actively learn through communication and collaboration with others.

While findings reveal technology is mainly being used for teacher-centered instruction, a correlation exists between student-centered instruction and technology use. Kim, Kim, Lee, Spector, and DeMeester (2013) found teachers with more student-centered epistemologies showed a more seamless integration of technology. A constructivist teaching style was also determined to be a factor affecting the intensity with which teachers used technology (Petko, 2012). Furthermore, students responded positively to increased technology use (Desai, 2012). They reported feeling more engaged and gaining increased knowledge of content matter when using interactive technology devices, such as interactive whiteboards and response systems, in the classroom (Desai, 2012). These findings suggest that instructional methods focused on students are essential to create learning experiences which use technology in meaningful, authentic ways.

Teachers' motivations to use technology. In order to understand how technology is being used in K-12 classrooms, researchers have examined what motivates teachers to use technology and discovered several factors influencing their integration (Ertmer, Ottenbreit-Leftwich, & York, 2006; McCulloch, Hollebrands, Lee, Harrison, & Mutlu, 2018; Miranda & Russell, 2012; Ottenbreit-Leftwich, Glazewski, Newby, & Ertmer, 2010; Sadaf & Johnson, 2017; Sadaf, Newby, & Ertmer, 2012). For example, student learning is an essential factor influencing teachers' decisions to integrate technology (McCulloch et al., 2018). Pre-service teachers expressed a desire to improve student learning (Sadaf et al., 2012) while in-service teachers displaying exemplary technology use identified their commitment to student learning as one of the most influential factors guiding their technology use (Ertmer et al., 2006). Other motivations include beliefs teachers hold about the importance of technology for teaching (Miranda & Russell, 2012) and the value teachers place on students gaining digital literacy (Sadaf & Johnson, 2017). Additionally, teachers are motivated to integrate technology in order to improve professionally (Ottenbreit-Leftwich et al., 2010).

Effectiveness of technology use in the classroom. Despite teachers' intentions, studies into the effectiveness of technology use in the classroom show mixed results (Delgado et al., 2017; Harper & Milman, 2016). A review of current research into a one device per one student ratio of technology use in K-12 environments showed positive effects on student achievement in many content areas across many grade levels (Harper & Milman, 2016). However, this meta-analysis was limited in scope, examining research within a 10-year time period. Delgado et al. (2017) conducted a more extensive meta-analysis examining research within a 28-year time frame about the effectiveness of technology in K-12 classrooms. Their findings revealed significant effects evident in some studies, more so in math than reading, yet other studies showed no positive trend over time (Delgado et al., 2017). Tamin, Bernard, Borokhovski, Abrami, and Schmid (2011) conducted a second-order meta-analysis spanning 40 years of research relating to the effectiveness of technology use in classrooms compared to classrooms with no technology. Results showed significant effects for technology used to support student learning as opposed to technology used for direct instruction (Tamin et al., 2011). Relatedly, Harper and Milman (2016) note the use of one computing device per student caused changes in the classroom, namely differentiated instruction, changes in learning experiences, increased use of constructivist principles, and cooperative learning. Harper and Milman's (2016) findings indicate that technology used for student-centered, constructivist learning activities can be beneficial for students. While these results highlight research findings relating to the effectiveness of technology integration, the inherent flaws of meta-analyses must be acknowledged (Kennedy, 2007). Decisions the researchers made to constrain the scope of their analyses, such as deciding which databases to access and which search terms to use, create limitations in the results.

Online Learning in K-12 Education

Online learning in K-12 environments has increased steadily over the past 20 years (Greer, Rowland, & Smith, 2019). Digital Learning Collaborative (2019) estimates enrollment in fully online schools is increasing at a rate of 6% per year. Thirty-two states now allow statewide online schools (Digital Learning Collaborative, 2019), and Michigan became the first state to require high school students complete at least one course online prior to graduation (Barbour & Harrison, 2016). Despite this increase, research into the field has been shallow, but is growing (Arnesen, Hveem, Short, West, & Barbour, 2019). The following sections outline (a) a description of online learning, (b) skills required for online teaching, and (c) characteristics of effective online teachers as identified in the research.

Description of online learning. Many different names have been used to describe online learning. Some names found in the research include fully online, virtual learning, cyber learning, and e-learning (Greer et al., 2019). In addition to various names, several definitions exist with slight variations. Some definitions limited online learning to only include secondary schools or schools that were accredited by an official body (Greer et al., 2019). However, most definitions convey the broad categorization that online learning is an "online, internet-based or web-based distance education program available to K-12 schools and students" (Greer et al., 2019, p. 404). The International Association for K-12 Online Learning (2011) defines online learning as "Education in which instruction and content are delivered primarily over the Internet" (p. 7).

Three dominant methods of instruction for online learning have been identified in the literature (Barbour & Reeves, 2009). Methods differ in the amount of interaction between teachers and students, the resources provided by the school, and the level of independent learning required of the student. In independent instruction, a computer mediates the course, and the student teaches him or herself with minimal interaction from the teacher (Barbour & Reeves, 2009). During asynchronous instruction, the teacher plays a more significant role in guiding students, but they are still quite independent in their learning (Barbour & Reeves, 2009). Schools often utilize a course management system to facilitate interaction between students and teachers, and the school provides more resources than in independent instruction. Synchronous instruction describes an online environment where teachers and students meet in real time and students have access to interactive tools, such as messaging and hand raising (Murphy & Coffin, 2003). This method most closely resembles the face-to-face learning environment in that it allows teachers to use similar instructional methods (Barbour, 2012).

While there is significant variety in how online education is delivered, all methods of instruction depend on extensive use of technology (Barbour & Reeves, 2009). Teachers must manage their courses, including providing equitable access to materials for students, creating a positive learning experience, and sharing engaging content (DiPietro, 2010). Technology also serves as the vehicle to connect with their students, whether synchronously or asynchronously (DiPietro, 2010). To accomplish these tasks, online teachers must be skilled in basic uses of technology (DiPietro, Ferdig, Black, & Preston, 2010).

Skills required for online teaching. Online instruction requires teachers to use different skills than those used for face-to-face instruction (Barbour, 2012; Davis et al., 2007; Kennedy, Cavanaugh, & Dawson, 2013). Davis et al. (2007) suggest there is a paradigm shift in instructional time and space, virtual management techniques, and engagement methods for students when teaching online. With independent and asynchronous methods of instruction, teachers may not meet with students in real time. Therefore, they must use different pedagogical skills and strategies in the online environment to reach their students (Davis et al., 2007). Teaching online places technological demands on the teacher. In addition, teachers must be able to use multiple communication tools to reach their online learners (Archambault & Larson, 2015).

Teaching online requires the coordination of teachers' pedagogical skills, technological knowledge, content knowledge, and an understanding of their students (DiPietro, 2010).

Teachers employ different pedagogical strategies when teaching online because their role is different than teaching face-to-face. Kennedy et al. (2013) found preservice teachers participating in an online school practicum identified their role to be more of a facilitator for students in a virtual environment. DiPietro (2010) studied in-service online teachers and found their roles involved guiding knowledge construction and individualizing learning for students. The change in roles and pedagogical strategies has led some teachers to prefer certain methods of online instruction over others. For example, Barbour (2012) found teachers were drawn to synchronous online environments because they could use pedagogical methods already familiar to them, such as presenting slides and lecturing. Furthermore, teachers are not always able to translate their pedagogical skills into an online format. A meta-analysis of the literature revealed teachers were unable to utilize asynchronous instructional tools effectively beyond how they would assign work in a face-to-face classroom (Barbour, 2012). These findings suggest the shift in pedagogical approaches when teaching in an online environment is challenging for some teachers.

Teaching online requires the use of technology. Therefore, teachers need to possess strong technological skills in order to present content through technology (Archambault & Crippen, 2009). They must possess basic skills relating to technology but also continue to expand their technological knowledge by exploring new technologies for the virtual environment (DiPietro et al., 2010). Teachers need to have the skills and knowledge to tackle hardware and software issues when they arise (Archambault &

Crippen, 2009). In fact, teachers identified training on technology tools as the most valuable training to prepare teachers for online instruction (Archambault & Larson, 2015).

Effective communication is essential in online learning environments. Online teachers build relationships with their students through their methods of communication (DePietro, 2010). Teachers need to provide students with clear instructions to prevent misinterpretations and give students opportunities to ask questions (DiPietro, 2010). DiPietro (2010) found communication was a central component of the teacher-student relationship, which helped support student motivation and success. Additionally, how teachers communicate with students is different than the face-to-face environment. Teachers need to be able to communicate across many different platforms, such as discussion boards, email, and video chat (Archambault & Larson, 2015).

Despite the different skills required for online learning, many teacher training programs do not prepare teachers for instructing in an online environment. A survey of teacher education programs found only 1.3% are preparing teachers for virtual classrooms (Kennedy & Archambault, 2012). Education programs are not growing as quickly as the demand for online learning. Barbour (2012) suggested the limited amount of research into effective online K-12 programs explains the limited teacher education programs available. Instead of pre-service training, many teachers are learning how to teach online while on the job or through professional development (Archambault & Larson, 2015; Barbour, 2012).

Characteristics of effective online teachers. To be effective in an online learning environment, teachers must demonstrate coordinated knowledge of content, pedagogy, and technology (DiPietro et al., 2010). Archambault and Larson (2015) identified characteristics of effective online teachers as self-motivated, valuing learning and education, and enjoying the challenge and process of using technology for instruction. Additionally, effective online teachers continually expand their knowledge (DiPietro et al., 2010). For example, Kennedy et al. (2013) found teachers sought new tools to help their learners feel less distant in the online environment. Effective online teachers were also found to have extensive pedagogical knowledge in the virtual environment (DiPietro et al., 2010). Online teachers used multiple strategies to assess students, provided multiple ways for students to engage with content, and monitored student progress in order to address knowledge gaps (DiPietro et al., 2010).

Teachers' perceptions of online learning are also important to their practice (Archambault & Larson, 2015; Barbour & Harrison, 2016; DiPietro, 2010). Overall, online teachers were found to view online learning as positively impacting students (Barbour & Harrison, 2016). Teachers felt online learning removed social pressures, exposed students to technology tools, and increased student engagement and learning (Barbour & Harrison, 2016). Teachers identified good communication skills and being organized and prepared as important skills to be effective online teachers (Archambault & Larson, 2015).

A Theoretical Model for Technology Integration

Several models exist to describe technology integration. Some, such as technological pedagogical content knowledge (TPACK), describe the knowledge required for successful integration (Koehler & Mishra, 2009), while others rely on social psychology to determine the attitudes and perceptions that affect intentions (Taylor & Todd, 1995). The substitution, augmentation, modification, and redefinition (SAMR) model represents technology integration as a ladder (Puentedura, 2014). The model supports technology uses ranging from the simple substitution of technologies to sophisticated uses that redefine teaching and learning in ways not previously possible without technology (Puentedura, 2014). Regardless of which model is used, the process of technology integration is complex and involves many factors influencing teachers' decisions to use technology or not (Inan & Lowther, 2010). This section describes a few of the models for technology integration, including (a) the SAMR model, (b) two related models stemming from social psychology, and (c) the theoretical model used for this research, TPACK.

SAMR. Puentedura (2014) introduced the SAMR model that outlines technology integration. According to the model, there are four stages. The first stage is substitution, which describes using technology as a substitute for another tool. In this stage, the use of technology does not change the task but provides an additional way to complete the task. The augmentation stage refers to the use of technology in place of another tool but with added functionality. In other words, technology is used to augment or improve the means of completing a task. Puentedura states the first two stages enhance learning through their use of technology. The third stage, modification, uses technology to transform learning by significantly redesigning the task. Finally, the redefinition stage redefines learning through the use of technology to complete previously inconceivable tasks.

The SAMR model is more popular with K-12 teachers than other technology integration models (Kimmons & Hall, 2018), yet critics have expressed concern over the lack of empirical research relating to SAMR (Hamilton, Rosenberg, & Akcaoglu, 2016). A study of two social studies teachers who used the SAMR and TPACK models concluded that SAMR lent itself to student-centered instruction more than TPACK and was easier to apply (Hilton, 2016). Additionally, teachers felt the SAMR model was more practical and visually appealing than other technology integration models (Kimmons & Hall, 2018). Despite its popularity with teachers, critics of SAMR note the hierarchical nature of the model emphasizes the creation of a product using technology rather than the process of creating (Hamilton et al., 2016). Possibly the most significant criticism of the SAMR model is its lack of consideration of the learning context (Hamilton et al., 2016). Not all learning environments are the same. Classrooms are equipped with different types and amounts of technology resources, student needs vary within each class, and levels of support differ from administration, IT departments, and peers. These contextual factors affect integration, so a framework for technology integration must consider the context (Koehler & Mishra, 2009). Based on the lack of attention regarding the context in the SAMR model and the limited empirical research, this model was not selected to frame the current research.

Models derived from social psychology. Two technology integration models occurring in empirical research derive from the theory of reasoned action (Taylor & Todd, 1995). The theory of planned behavior (TPB) and the technology acceptance model (TAM) attempt to determine predictors of technology usage. The TPB states intentions to perform a behavior can be predicted based on the attitudes, perceived social pressures, and perceived difficulty of performing the behavior (Ajzen, 1991). The TAM identifies the perceived ease of use and perceived usefulness of the technology as direct determinants of a person's attitude toward technology, which in turn impacts intentions to use the technology (Davis, 1989). Both of these models are supported by the underlying beliefs people hold about technology.

The TPB and TAM have been used by researchers as theoretical frameworks for studying technology integration in K-12 schools. Findings reveal beliefs and attitudes toward technology play a significant role in influencing teachers' actions. Researchers found perceived usefulness to be the strongest factor in teachers' decisions to adopt technology in rural school districts (Vareberg & Platt, 2017). Teachers cite increasing student engagement as an important reason to use technology (Sadaf & Johnson, 2017; Vareberg & Platt, 2017). When examining pre-service teachers' intentions to integrate technology, researchers found that attitudes were the most significant predictor of motivations to use technology (Cullen & Greene, 2011). A meta-analysis on the TAM found statistically significant results supporting perceived usefulness, perceived ease of use, and attitudes as predictors of behavioral intentions (Scherer & Teo, 2019). These models provide important considerations for the current research because they address the role beliefs and attitudes play in influencing actions.

TPACK. The TPACK model is based off the work of Shulman (1986) and his identification of pedagogical content knowledge, which outlines the knowledge teachers must possess about teaching and learning (Harris, Phillips, Koehler, & Rosenberg, 2017). Koehler and Mishra (2009) expanded Shulman's work to include technology as a knowledge domain for teachers when integrating technology. Thus, the TPACK framework (see Figure 2.1) includes three main knowledge areas: content knowledge, pedagogical knowledge, and technological knowledge (Koehler & Mishra, 2009). Content knowledge refers to the knowledge teachers have about the subject they are teaching. This domain is crucial for teachers and includes fundamental knowledge about their content areas. Pedagogical knowledge refers to what teachers know about how to teach. This includes classroom management, lesson planning, student assessment, and an understanding of how students learn. Technological knowledge relates to teachers having a broad understanding of technology and an ability to use it to increase productivity. Each of these three domains interacts with one another during technology integration. Teachers must possess knowledge about how technology interacts with their content and can be used to afford or restrain it; this is referred to as technological content knowledge. Technological pedagogical knowledge relates to understanding how teaching and learning change when certain technologies are used. Koehler and Mishra (2009) also acknowledged the important role of context in teaching and learning and how context can change the interaction of the three domains. Therefore, TPACK requirements are specific not only to each grade level and content area, but also each classroom.

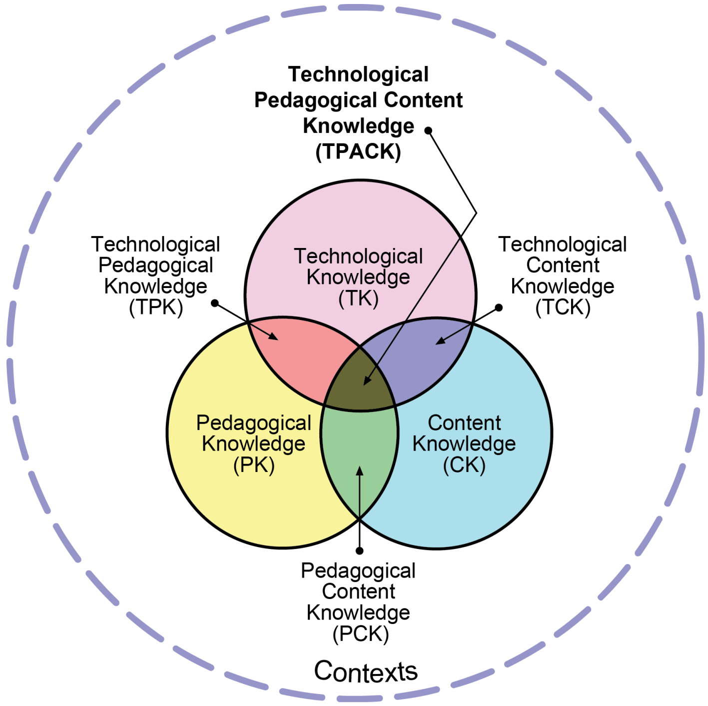

Figure 2.1. Koehler and Mishra's TPACK framework. Reproduced with permission of the publisher. ©2012 by tpack.org.

TPACK is widely used by researchers to study technology integration and inform teacher preparation programs (Kimmons & Hall, 2018). One strength of the TPACK model is its broad description of the knowledge teachers need in order to integrate technology into their classrooms (Brantley-Diaz & Ertmer, 2013). Researchers exploring teachers' perceptions of theoretical frameworks for technology integration expressed a need to have technology use connected to theory (Kimmons & Hall, 2018). However, other researchers have noted that TPACK was designed for researchers and teacher educators, not as a framework for teachers to use when creating lesson plans (Brantley-Diaz & Ertmer, 2013). Additionally, critics argue that TPACK is overly complex and places too much emphasis on technology (Brantley-Diaz & Ertmer, 2013). Despite these criticisms, research has found teachers perceived technology knowledge as having a direct influence on TPACK, even more so than technological pedagogical knowledge (Koh, Chai, & Tsai, 2013), and TPACK positively influenced teachers' self-efficacy, perceived ease of use, and perceived usefulness (Joo, Park, & Lim, 2018).

For this research study, the TPACK model was used to frame technology integration. Technology integration involves more than just technological knowledge, pedagogical knowledge, content knowledge, and the interaction of these knowledge domains. Koehler and Mishra (2009) identified the important role context plays in technology integration and included subject matter, grade level, student background, and available technology resources as components of the learning context. However, the beliefs and attitudes people hold toward technology also influence their decision to use technology (Davis, 1989). There is some support provided in the literature to include teachers' beliefs as a component of the context related to the TPACK framework (Rosenberg & Koehler, 2015). Porras-Hernández and Salinas-Amescue (2013) expanded on the notion of context to include design features within the room, the school setting and learning environment, state and national standards, student characteristics, and teachers' motivation and beliefs. Therefore, the current study uses the knowledge domains outlined in the TPACK framework while also recognizing the significant role beliefs and attitudes play in affecting behavior through the TPB and TAM.

Factors Affecting Technology Integration

Technology integration is a complex process involving many factors which can affect integration. Some teachers are motivated to use technology because they believe it is important for teaching (Miranda & Russell, 2012), while others are motivated to improve student learning through technology use (Ertmer et al., 2006). Conversely, some teachers face obstacles that prevent them from integrating technology. These obstacles may be intrinsic to the teacher or extrinsic and out of his or her control (Ertmer, 1999). This section explores factors that serve as (a) enablers of technology integration and (b) barriers to technology integration.

Enablers of Technology Integration

Identifying those factors that positively influence teachers can assist schools in leveraging technology for learning in the classroom. The knowledge teachers must possess in order to integrate technology is outlined in the TPACK framework, yet teachers' beliefs and attitudes also affect their decision to use technology. The following paragraphs examine how (a) teachers' knowledge and prior experience, (b) attitudes toward technology, and (c) beliefs about technology for teaching and learning can act as enablers of technology integration.

Teachers' knowledge and prior experience. Research indicates teachers' knowledge and experience with technology affect their decisions to integrate (Inan & Lowther, 2010; Miranda & Russell, 2012; Mueller et al., 2008; Petko, 2012; Polly, Mims, Shepherd, & Inan, 2010). Specifically, teachers' prior experiences with technology and their competency in using technology impact integration (Inan & Lowther, 2010; Miranda & Russell, 2012). Petko's (2012) study of teachers in Switzerland found computer competency to be one of five factors affecting the intensity with which teachers use technology. A study of pre-service teachers who participated in technology integration activities reported more technical knowledge, higher stages of adoption, and more integration during field experiences (Polly et al., 2010). These findings suggest that when teachers know how to use technology tools effectively, they achieve higher levels of integration.

Teachers' attitudes toward technology. Research findings reveal attitude toward technology is a significant factor influencing integration (Coleman, Gibson, Cotten, Howell-Moroney, & Stringer, 2016; Mueller et al., 2008; Pittman & Gaines, 2015; Tondeur, Aesaert, Prestridge, & Consuegra, 2018; van Braak, Tondeur, & Valcke, 2004). Studies involving pre-service teachers (Tondeur et al., 2018) and practicing teachers (Coleman et al., 2016; van Braak et al., 2004) found attitudes toward technology positively impacted their use of technology in the classroom. Pittman and Gaines's (2015) survey of 75 primary school teachers concluded that the strongest correlation to technology integration was teachers' attitudes toward technology. Additionally, a study of high integrators and low integrators determined attitudes toward technology to be one of the most distinguishing characteristics between the two groups (Mueller et al., 2008). Findings from these studies indicate that a positive attitude toward technology is one requirement for effective integration.

Teachers' beliefs about technology. Research into technology integration has identified teachers' personal beliefs as a factor affecting integration (Ertmer et al., 2006; Inan & Lowther, 2010; McCulloch et al., 2018; Miranda & Russell, 2012; Petko, 2012; Vannatta & Fordham, 2004). Several studies have identified teachers' beliefs about the benefits of technology for student learning as one of the strongest predictors of use (McCulloch et al., 2018; Miranda & Russell, 2012; Petko, 2012). Vannatta and Fordham (2004) argue that teachers' philosophy and willingness to change are significant factors affecting integration. Technology teachers identified as exemplary technology users rated internal beliefs and commitment to student learning as the most influential factors guiding their technology use (Ertmer et al., 2006). Teachers' self-efficacy with technology has been found to be another significant predictor of technology use (Gu et al., 2013; Holden & Rada, 2011; Vareberg & Platt, 2018). Additionally, the perceived usefulness and importance of technology for teaching was recognized as one of the most significant factors affecting teachers' decisions to adopt technology (Miranda & Russell, 2012; Vareberg & Platt, 2018).

Barriers to Technology Integration

Teachers may encounter factors that influence them to implement technology in their classrooms, but they may also encounter barriers that hinder technology integration. Such barriers to integration are defined as "existing conditions that render the successful implementation of [information and communication technologies] in educational settings difficult to achieve" (Makki et al., 2018, p. 91). Research into barriers deterring technology integration stretches back more than two decades with Ertmer (1999) being one of the first to classify barriers as first-order and second-order. Her seminal work identified first-order barriers as "extrinsic to teachers and include lack of access to computers and software, insufficient time to plan instruction, and inadequate technical and administrative support" (Ertmer, 1999, p. 2). In other words, first-order barriers are those factors that are external to teachers but impact their teaching practices. By contrast, second-order barriers are "intrinsic to teachers and include beliefs about teaching, beliefs about computers, established classroom practices, and unwillingness to change" (Ertmer, 1999, p. 2). These barriers are specific to each teacher and originate internally. Research suggests both internal and external barriers continue to affect technology integration

(Jones, Smith, & Cohen, 2017; Petko, 2012; Wachira & Keengwe, 2010). The following paragraphs examine (a) first-order barriers, (b) second-order barriers, and (c) overcoming barriers.

First-order barriers. Evidence of first-order barriers impacting technology integration is well-documented in the literature (An & Reigeluth, 2011; Francom, 2016; Hew & Brush, 2007; Karsenti, 2016; Wachira & Keengwe, 2010). Not having access to technology or technology resources has been noted as a significant barrier to integration (Francom, 2016; Hew & Brush, 2007; Petko, 2012; Wachira & Keengwe, 2010). Lack of access may occur when teachers share devices among classrooms or when technology is located in central locations, such as lab settings or media centers. However, Hsu (2016) argued that access to technology was less of a barrier than teachers' knowledge and skills to implement technology, lack of time to plan, and lack of training. Other studies offer evidence to support these barriers. Teachers report not having time to plan lessons that incorporate technology prevents them from using it in their classrooms (An & Reigeluth, 2011; Francom, 2016; Hew & Brush, 2007). Lack of training can inhibit technology use because teachers are not familiar with how to use the tools in the classroom (Karsenti, 2016). When teachers lack resources, such as technical support, they are deterred from using technology tools (An & Reigeluth, 2011; Hew & Brush, 2007; Shifflet & Weilbacher, 2015). Support from leadership is also necessary for successful integration as findings reveal a lack of administrative support in schools hampers integration (Francom, 2016; Jones et al., 2017; Wachira & Keengwe, 2010). Additional external barriers noted in the literature include students' technology ability (Hsu, 2016; Shifflet & Weilbacher, 2015) and assessment (An & Reigeluth, 2011). It is evident that teachers encounter a variety of external obstacles that can hinder their efforts to implement technology.

Second-order barriers. While first-order barriers still present challenges to integration, second-order barriers are also at play. Ertmer et al. (2012) noted the significant role of internal factors in helping shape classroom teachers' practices involving technology. For example, the knowledge and skills required to integrate technology can prevent teachers from using it in their classrooms (Hew & Brush, 2007; Hsu, 2016; Jones et al., 2017; Wachira & Keengwe, 2010). This includes knowledge of specific technology as well as ways technology can be used to support pedagogical practices. Teachers' fear of maintaining control in the classroom while using technology is another internal factor affecting integration (Hew & Brush, 2007; Vareberg & Platt, 2018). Perhaps the strongest internal barrier to integration is teachers' beliefs. The extant literature offers support that teachers' beliefs serve as a significant obstacle to integration (Gu et al., 2013; Hermans, Tondeur, van Braak, & Valcke, 2008; Hew & Brush, 2007; Jones et al., 2017). Some studies have specifically noted that teachers' beliefs in their own abilities to use technology, or self-efficacy, is a hindrance (Jones et al., 2017; Li, Li, & Franklin, 2016; Vareberg & Platt, 2018; Wachira & Keengwe, 2010). Hew and Brush's (2007) meta-analysis of technology integration recognized teachers' attitudes and beliefs, especially the value teachers see in using technology for teaching and learning, to be a significant barrier. Vareberg and Platt's (2018) study provides support as teachers were reluctant to adopt technology when they did not see a clear purpose for using it. Second-order barriers may be less overt than first-order barriers, but they can impact effective technology integration.

Overcoming barriers. Teachers may encounter both first- and second-order barriers when trying to integrate technology. Despite these challenges, some teachers are able to overcome barriers to integration. Researchers have offered a variety of suggestions for how best to overcome barriers (Ertmer, 1999; Ertmer et al., 2012; Heath, 2017; Hew & Brush, 2007; Kopcha, 2012; Shifflet & Weilbacher, 2015). Professional development is touted by many as a means to help teachers achieve technology integration (Ertmer, 1999; Ertmer et al., 2012; Hew & Brush, 2007; Kopcha, 2010, 2012). Several different approaches have been suggested, such as communities of practice coupled with mentoring (Kopcha, 2010, 2012) and training focused on providing meaningful uses of technology (Ertmer, 1999). Hew and Brush (2007) suggested creating a shared vision and technology integration plan, reconsidering assessments, and changing attitudes and beliefs to address barriers to technology integration. Research findings offer some support for the suggestion of addressing teachers' beliefs as a way to overcome barriers. Walker and Shepard (2011) studied teachers who successfully integrated technology and determined they overcame barriers because they were motivated to deliver instruction and did not abandon lesson plans when technology failed. Similarly, Heath (2017) surmised teachers' positive beliefs toward technology and confidence in their ability to act as agents of change allowed them to overcome barriers. While these findings are encouraging, not all teachers have been able to overcome barriers to integration, even when they held positive beliefs about technology (Shifflet & Weilbacher, 2015).

Many factors affect technology integration and can motivate or hinder use in the classroom. Teachers' knowledge and prior experiences with technology can positively influence integration. Favorable attitudes toward technology are also a factor, and teachers who possess these may be more inclined to use technology in their classrooms. However, teachers cannot use technology if they do not have access to it. Lack of technology resources, support, and training can also negatively impact technology use in classroom. Teachers' beliefs play a significant role in integration. They can serve to motivate some teachers to use technology while hindering others' ability to integrate.

Teachers' Beliefs About Teaching and Learning

Pajares (1992) defined teachers' beliefs as "[teachers'] attitudes about education—about schooling, teaching, learning, and students" (p. 316). What teachers' believe about teaching and learning impacts their behavior in the classroom. Identifying teachers' beliefs and what drives the enactment of beliefs is necessary to understand the choices teachers make within their classrooms. This section examines (a) the characteristics of teachers' beliefs, (b) the types of beliefs teachers hold about technology in the classroom and how they can affect integration, (c) and how teachers' beliefs align with their classroom practices.

Characteristics of Teachers' Beliefs

Beliefs have been described by Pajares (1992) as a "messy construct," suggesting there is disagreement surrounding the definition and description of beliefs (p. 307). However, there is some consensus on the characteristics and functions of teachers' beliefs within the literature. First, beliefs have been described as separate from knowledge (Ertmer, 2005; Nespor, 1987; Pajares, 1992). One reason is due to the evaluative nature of beliefs (Nespor, 1987; Pajares, 1992). Knowledge is often thought of as factual information, yet beliefs consist of judgments and presumptions (Pajares, 1992). Pajares

(1992) succinctly summarizes this distinction as knowing about a domain versus having feelings about a domain. Understanding how the evaluative nature of beliefs is different from knowledge is important in order to recognize that the beliefs teachers hold can determine the amount of energy they will expend on an activity (Nespor, 1987). For example, if a teacher has a positive view of technology for teaching, he or she may be willing to spend additional time learning to use technology or create lessons that implement technology.

Another distinction between beliefs and knowledge is that beliefs are formed from personal experiences (Nespor, 1987; Pajares, 1992). Nespor (1987) suggests early experiences can be critical as beliefs laden with subjectivity, power, and legitimacy derive from them and frame future experiences. Pajares (1992) supports the idea that early experiences carry power and influence as he notes, “the earlier a belief is incorporated into the belief structure, the more difficult it is to alter, for these beliefs subsequently affect perception and strongly influence the processing of new information” (p. 317). One impact this has on the classroom is that teachers’ practices are derived from their own early experiences in a classroom (Nespor, 1987). This suggests teachers who experienced teacher-centered learning environments during their own schooling develop beliefs and attitudes about the effectiveness of these instructional strategies.

Most of the theoretical literature on teachers’ beliefs suggest they are part of an integrated system of beliefs (Fives & Buehl, 2013; Nespor, 1987; Pajares, 1992). In other words, beliefs are connected to other beliefs. Rokeach (1968) explained this connection as follows: “the more a given belief is functionally connected or in communication with other beliefs, the more implications and consequences it has for other beliefs and, therefore, the more central the belief" (p. 5). When beliefs form around an object or situation, this creates attitudes, which in turn become actions (Pajares, 1992). Furthermore, Pajares (1992) described beliefs, attitudes, and values as the components of an individual's belief system.

Beliefs have many functions that affect teachers' actions within the classroom. First, beliefs help someone to filter information and experiences (Fives & Buehl, 2013; Nespor, 1987; Pajares, 1992). This function is important for teachers because it means beliefs can affect the way they interpret new knowledge (Fives & Buehl, 2013). Second, beliefs frame problems and situations (Fives & Buehl, 2013; Nespor, 1987). Nespor (1987) argues teaching presents ill-structured problems that require teachers to rely on their belief systems in order to solve. Once teachers have filtered information presented about a problem, they use their beliefs to conceptualize the problem (Fives & Buehl, 2013). Finally, beliefs guide intention and action (Fives & Buehl, 2013; Nespor, 1987). Fives and Buehl (2013) note a central function of beliefs is "their motivational abilities to move teachers to action" (p. 480). Beliefs influence how teachers filter information, use that information to frame a situation, and ultimately act in that situation.

Another characteristic of beliefs identified in the literature is that beliefs are stable (Fives & Buehl, 2013; Nespor, 1987; Pajares, 1992). In other words, beliefs do not change significantly over time. Pajares (1992) notes that newer beliefs can be vulnerable to change, but long-held beliefs become very resistant to change, even when those beliefs are incorrect. Nespor (1987) concurs and states, "When beliefs change, it is more likely to be a matter of a conversion or gestalt shift than the result of argumentation or a marshaling of evidence" (p. 321). Therefore, beliefs are powerful, and older beliefs may hold the most power because teachers can be reluctant to let go of them.

Teachers' Beliefs and Their Effects on Technology Integration

Teachers' beliefs and attitudes impact their actions within the classroom, including their decision to use technology or not. However, teachers' beliefs are broad and cover a variety of different beliefs (Taimalu & Luik, 2019), such as pedagogical beliefs, value beliefs, and self-efficacy. Research suggests these beliefs are interrelated and serve as the main predictors of technology integration (Hsu, 2016). This section examines how (a) pedagogical beliefs, (b) value beliefs, and (c) self-efficacy affect teachers' integration of technology.

Pedagogical beliefs. Teachers' pedagogical beliefs relate to what teachers believe about the nature of teaching and learning (Tondeur, van Braak, Ertmer, & Ottenbreit-Leftwich, 2017). They are often classified in the literature as being either teacher-centered or student-centered (Deng, Chai, Tsai, & Lee, 2014). Teacher-centered beliefs are typically associated with behaviorism and may be called traditional pedagogical beliefs, whereas student-centered beliefs are associated with constructivism (Deng et al., 2014). Student-centered activities allow learners to construct knowledge actively rather than passively receiving knowledge from the teacher.

What teachers believe about the nature of knowledge influences their pedagogical beliefs (Deng et al., 2014; Kim et al., 2013). Teachers who feel knowledge comes from authority tend to use more of a teacher-centered approach to instruction (Deng et al., 2014). These traditional beliefs negatively impact technology use (Hermans et al., 2008; Taimalu & Luik, 2019; Tondeur et al., 2017). Teacher-centered instruction involving technology has been associated with low-level cognitive tasks, such as practice activities (Polly & Rock, 2016). Researchers have noted teachers with constructivist beliefs use technology more for teaching and learning (Hermans et al., 2008; Tondeur et al., 2017) and use it for constructivist purposes (Deng et al., 2013). Additionally, teachers who use technology for student-centered instruction have shown more seamless integration (Kim et al., 2013). A constructivist teaching style also impacts the intensity with which teachers use technology in the classroom (Petko, 2012). This suggests that teachers who hold pedagogical beliefs favoring student-centered instruction are able to create meaningful, authentic tasks for students through the use of technology.

However, teachers' pedagogical beliefs are not mutually exclusive. Teachers may hold both student-centered and teacher-centered beliefs (Tondeur et al., 2017; Walker & Shepard, 2011). Tondeur et al. (2017) found that pedagogical beliefs and technology use exist in a bi-directional relationship, suggesting teachers' beliefs can influence teachers' use of technology and vice versa. These findings imply positive uses of technology can shape teachers' beliefs about how technology can be used for learning.

Value beliefs. Teachers' value beliefs relate to "the belief about the value of technology for their teaching practice" (Vongkulluksn, Xie, & Bowman, 2018, p. 71). The value teachers believe that technology has in helping achieve their instructional goals can impact their integration decisions (Hew & Brush, 2007; Ottenbreit-Leftwich et al., 2010). Researchers have found value beliefs positively affected teachers' technology knowledge and their integration (Sadaf & Johnson, 2017; Taimalu & Luik, 2019). Furthermore, positive beliefs about the value of technology for teaching and learning predicted how much teachers and students used technology (Miranda & Russell, 2012;

Mueller at al., 2008). Value beliefs also predicted the quality and quantity of technology integration (Vongkulluksn et al., 2018).

Beliefs teachers hold about the value of technology can impact technology use in other ways as well. Value beliefs can affect teachers' use of technology for professional needs as well as student needs. For example, Ottenbreit-Leftwich et al. (2010) found that teachers valued technology as a means to increase their efficiency and effectiveness, but they also valued technology to engage students, enhance reading comprehension, and teach technology skills. Additionally, teachers' value beliefs may affect how they perceive external barriers to integration. For example, teachers who value technology may perceive limited access to technology resources differently than teachers who value technology less because they work around the constraints (Vongkulluksn et al., 2018).

Self-efficacy. Self-efficacy has been identified as a significant component of technology integration (Ertmer & Ottenbreit-Leftwich, 2010; Gu et al., 2013). Self-efficacy beliefs are defined as "personal beliefs about one's ability to learn and perform actions at desired levels" (Hsu, 2016, p. 31). In terms of technology integration, self-efficacy relates more to teachers' confidence in their abilities to use technology rather than competence in technology use (Taimalu & Luik, 2019). In other words, teachers need to believe that they are capable of using technology for instruction if they are going to integrate it.

Teachers' self-efficacy has been identified as a significant barrier to integration in the related literature (Jones et al., 2017; Vareberg & Platt, 2018; Wachira & Keengwe, 2010). If teachers lack confidence in their ability to use technology for teaching, they are unlikely to use it. Conversely, high self-efficacy can motivate teachers to use technology

(Cullen & Greene, 2011). In fact, self-efficacy has been identified as a significant predictor of technology use for teachers (Gu et al., 2013). It has been noted as a factor in pre-service teachers' intentions to adopt technology (Li et al., 2016) and practicing teachers' acceptance of technology (Holden & Rada, 2011). Teachers' self-efficacy can have far-reaching effects, including reducing other barriers to integration. For example, teachers' beliefs in their abilities to integrate technology and serve as agents of change allowed them to overcome other obstacles to integration (Heath, 2017). Heath (2017) noted teachers who were confident in their technological abilities displayed a willingness to take risks, persevere to solve technical problems, and take initiative to address technical needs.

Teachers' pedagogical beliefs, value beliefs, and self-efficacy are interrelated and all three impact technology integration. Researchers have found a correlation exists between constructivist beliefs, high self-efficacy, and positive beliefs about the value of technology for instruction (Hsu, 2016; Taimalu & Luik, 2019). Teachers with higher value beliefs displayed more student-centered technology use in their classrooms (Ertmer et al., 2012; Hsu, 2016). Self-efficacy has been found to directly impact teachers' perceptions of how easy technology is to use and how useful it is for teaching and learning (Holden & Rada, 2011). These findings suggest teachers who hold constructivist beliefs, have confidence in their ability to use technology, and identify value in using technology for learning may be more inclined to use it in their classrooms.

Alignment of Beliefs and Practices

Teachers' beliefs play a significant role in the behaviors they enact in the classroom. However, research into the alignment of teachers' beliefs and practices has drawn inconsistent results, with some researchers finding alignment between beliefs and practices while others do not (Ertmer, 2005; Fives & Buehl, 2013). Beliefs are complex and multifaceted. Tondeur et al. (2017) suggest that teachers may hold varying degrees of both student-centered and teacher-centered beliefs, and research provides evidence supporting this as teachers exhibited both traditional and constructivist practices in their classrooms (Orlando, 2013; Shifflet & Weilbacher, 2015). Furthermore, findings suggest there may be a teacher perception that curriculum dictates teacher-centered instruction (Chen, 2008; Liu, 2011; Orlando, 2013). The following paragraphs synthesize the empirical research regarding the alignment of teachers' beliefs and practices.

Studies examining teachers' beliefs have found that teachers with constructivist beliefs exhibited alignment in their classroom practices (Deng et al., 2013; Ertmer et al., 2012; Hsu, 2016). Deng et al. (2013) determined teachers' epistemic beliefs and pedagogical beliefs existed in a nested relationship, and their instructional uses of technology were in alignment with their beliefs. Ertmer et al. (2012) examined 12 award-winning teachers recognized for their technology integration and found through interviews and observations that their enacted practices aligned with their stated beliefs. For example, one teacher stated technology should be used for student-centered, authentic applications, and her observed classroom practices included using iMovie software and digital storytelling (Ertmer et al., 2012). Additionally, Hsu (2016) determined a significant majority (75%) of the teachers in her study held constructivist beliefs, and their beliefs were in alignment with their classroom practices. Alignment was evidenced through multiple high-level learning activities in teachers' lessons (Hsu, 2016).

Researchers studying alignment of teachers' beliefs and practices have found teachers do not always enact their espoused beliefs in the classroom (Chen, 2008; Liu, 2011; Mama & Hennessy, 2013; Polly & Hannafin, 2011; Shifflet & Weilbacher, 2015). A case study of two teachers found their stated beliefs about technology use in the classroom were positive and aligned with constructivist uses of technology, yet some of their classroom practices did not match their stated beliefs (Shifflet & Weilbacher, 2015). A larger qualitative study found even when teachers held positive beliefs about technology use in education and recognized its value for teaching and learning, teachers' practices did not reflect these beliefs (Mama & Hennessy, 2013). The findings suggest teachers struggle for various reasons to enact constructivist methods even when their beliefs align with these practices.

Two studies conducted in Taiwan suggest that cultural emphasis on academic achievement may drive teachers to utilize teacher-centered methods (Chen, 2008; Liu, 2011). Another factor affecting alignment of beliefs and practices may be teachers' lack of fully understanding how to implement constructivist strategies (Chen, 2008). Polly and Hannafin's (2011) study supports this idea as they observed teachers with constructivist beliefs felt they were using student-centered strategies in their classrooms, although they were not. However, when these teachers participated in professional development focused on student-centered instruction, the alignment between their beliefs and practices increased (Polly & Hannafin, 2011). While the research is inconclusive concerning whether teachers' beliefs align with their practices, there is a need to understand what teachers' believe about teaching and learning in order to determine why these discrepancies in alignment are occurring.

Professional development to shape teachers' beliefs. If teachers' beliefs significantly impact technology integration, then it would follow that changing teachers' beliefs could have a positive effect on technology use in the classroom. The literature suggests that professional development is capable of shaping teachers' beliefs (Ertmer, 2005; Ertmer & Ottenbreit-Leftwich, 2010; Ertmer & Ottenbreit-Leftwich, 2013). Professional development has been identified as a factor positively affecting technology integration (Cifuentes et al., 2011; Coleman et al., 2016; Ertmer et al., 2006; Vannatta & Fordham, 2004). Moreover, findings show teachers who received more technology-related professional development used technology more in their classrooms (Blackwell et al., 2013; Pittman & Gaines, 2015). Ertmer (2005) suggests teachers' pedagogical beliefs can be shaped through professional development by using personal experiences, vicarious experiences, and social-cultural experiences where teachers learn through discussions with other teachers. In addition, professional development needs to provide teachers with technical knowledge and support for creating meaningful, authentic learning experiences with technology (Ertmer & Ottenbreit-Leftwich, 2010; Ertmer et al., 2015).

Studies examining teachers' beliefs and the effects of professional development have produced some positive results. Research findings support professional development effectively building teachers' technical skills and increasing their comfort with technology (Makki et al., 2018; Walker & Shepard, 2011). Increasing teachers' knowledge and comfort can impact their beliefs and attitudes about technology use. For example, Wang, Ertmer, and Newby (2004) found teachers' self-efficacy toward integration significantly increased after participating in vicarious learning experiences. Additionally, teachers' perceived ease of use increased through professional development

(Vareberg & Platt, 2018). Teachers' pedagogical beliefs have also been addressed through professional development. Levin and Wadmany (2006) conducted a longitudinal study over three years and determined that teachers' beliefs and practices changed after participating in a technology-rich environment. Teachers' classroom practices shifted to being more inquiry-based and exploratory (Levin & Wadmany, 2006). A more recent study by Polly and Hannafin (2011) found professional development to be successful in shifting teachers' pedagogical practices to more student-centered instruction. While teachers' beliefs are considered stable and resistant to change (Pajares, 1992), these findings suggest professional development can be effective in changing teachers' beliefs. However, a thorough understanding of teachers' beliefs is necessary in order to create professional development that can accurately address teachers' needs.

Chapter Summary

In conclusion, technology has continued to advance over the last few decades, yet classrooms are not taking advantage of the increase in access by using technology in authentic, meaningful ways. Instead, many teachers continue to use technology as a means to deliver instruction rather than as a tool for learning. Even in online learning environments where technology serves as the delivery tool, teachers continue to use technology in ways that mimic in-person, teacher-centered instruction (Barbour, 2012). Studies examining integration have identified internal and external factors that hinder embedding technology into instructional practices (Ertmer, 1999; Hew & Brush, 2007). However, as schools have addressed external barriers by increasing technology resources and support for teachers, pedagogical changes have not followed. This suggests that teachers' beliefs and attitudes are a significant factor even when external barriers have been reduced or eliminated. Teachers' beliefs are complex, often based on their own experiences with learning, and resistant to change (Pajares, 1992). It is necessary to understand teachers' beliefs to understand their intentions and actions within the classroom. Effective technology integration, whether online or in person, requires a pedagogical shift whereby teachers utilize technology as a cognitive tool. Identifying teachers' deep-seated beliefs about the role of technology in teaching and learning is a crucial step in affecting this change.

CHAPTER 3

METHOD

The purpose of this action research was to describe teachers' beliefs about technology integration at a school for students with dyslexia. This study sought to identify teachers' beliefs about technology in order to create an action plan to improve technology use throughout the school's classrooms. This action research study addressed the following research questions:

1. What are new online teachers' beliefs about the role of technology in teaching and learning at a school for students with dyslexia?
2. What are new online teachers' perceived barriers to technology integration at a school for students with dyslexia?
3. How do new online teachers' observed classroom practices align with their stated beliefs about technology?

Research Design

An action research study (Mertler, 2017) was conducted in order to answer the research questions. This study sought to understand the beliefs that teachers held toward technology for learning and their experiences with integrating technology in order to identify the factors that kept teachers from fully utilizing the tools available. The action research method was appropriate to identify and address the factors affecting technology integration in order to enact change at my school (Mertler, 2017).

Action research is defined as “any systematic inquiry conducted by teacher researchers, principals, school counselors, or other stakeholders in the teaching/learning environment to gather information about how their particular schools operate, how they teach, and how well their students learn” (Mills, 2018, p. 10). The roots of action research are often traced back to Kurt Lewin and his belief that theory and practice should be connected with the goal being continuous improvement (Johnson & Christensen, 2017). Whereas traditional research seeks to add to an existing body of knowledge, action research focuses on the application of knowledge. Therefore, action research in a school setting seeks to promote educational change that enhances the lives of children and other stakeholders (Mills, 2018). This is achieved through four steps: (1) identifying an area of focus, (2) collecting data, (3) analyzing and interpreting data, and (4) developing an action plan (Mills, 2018). Additionally, reflecting is a critical part of the action research process where researchers examine their actions, interactions, and results in order to improve their professional practice and identify future research topics (Johnson & Christensen, 2017; Mertler, 2017). This cyclical nature of action research provides the framework for continuous improvement within an organization.

The characteristics of action research make it the best method for understanding the barriers teachers face when integrating technology at my school. First, action research is focused on examining a specific location for the purpose of improving or problem solving at a local level (Mertler, 2017). My research sought to study the problem of technology integration at my school in order to enact change. Additionally, Merriam and Tisdell (2016) note that action research “seeks to engage participants at some level in the process in order to solve a practical problem” (p. 49). In this study, teachers not only were participants but engaged in the research process as I solicited their opinions about actions that could be undertaken to solve the problem of technology integration at my school. Exploring this problem in depth allows my school to affect positive educational change by creating action steps based on the findings of this research. Teachers will further be engaged in the process as these action steps are carried out.

This action research study utilized a convergent mixed methods design (Creswell & Plano Clark, 2018). Central to mixed methods research is the belief that combining quantitative and qualitative data will provide a more complete understanding of the research problem (Creswell, 2014). The convergent mixed methods design is characterized by two data sources (i.e., quantitative and qualitative) collected at roughly the same time (Creswell & Plano Clark, 2018). In this study, quantitative data was collected in order to describe how teachers are integrating technology at my school. Furthermore, this data was used to identify participants for follow-up interviews and observations. Morgan (2014) notes using quantitative methods to carefully select participants for qualitative studies allows the researcher to “target the most productive or theoretically relevant sources” (p. 17). Qualitative research emphasizes description, exploration, and a search for meaning (Rudestam & Newton, 2007). It seeks to understand other people’s perspectives and experiences and the interpretations they bring to situations (Frels & Onwuegbuzie, 2013). Hallmarks of qualitative research include exploring a phenomenon in a natural setting, collecting multiple sources of data, using inductive and deductive data analysis, focusing on the meaning participants ascribe to the situation, and allowing theories to emerge from the data (Creswell, 2014). Therefore, a qualitative approach allowed me to study in-depth the phenomenon of technology integration at my school and develop meaning from participants' responses and actions. Ultimately, findings from two sources of data collection were converged to develop a comprehensive understanding of teachers' beliefs about technology and barriers in their practices of integrating technology (Creswell & Plano Clark, 2018).

Setting and Participants

This action research study took place at a small, private school in the southeastern United States. All students attending the school were diagnosed with the learning disability dyslexia. The school offered reading remediation for students with dyslexia through an intensive phonics-based method, the Orton-Gillingham Approach. This approach emphasizes multisensory methods of instruction, and teachers are trained to design learning activities that incorporate seeing, hearing, feeling, and an awareness of motion (Orton-Gillingham Academy, 2018). All teachers at the school were taught to use these multisensory instructional methods for remediation of dyslexia.

The school is one of only 15 schools in the country certified by the Orton-Gillingham Academy. Due to the remediation focus, students typically attend the school for three or four years before returning to a mainstream school. The school maintains a population of 250 students enrolled in kindergarten through sixth grade. Classes are capped at 10 students in order to provide specialized reading instruction, making a total of 25 classes within the school. Every classroom is assigned two teachers who work together in a co-teaching relationship and share teaching responsibilities throughout the day. In addition to 50 classroom teachers, the school employs five teachers who cover curriculum relating to digital and print media, art, music, and physical education. Therefore, the total number of faculty members at the school is 55.

As noted in Chapter One, teachers had ample access to technology. In addition to every classroom being equipped with a Smart Interactive Display, all teachers were issued an Apple MacBook Pro laptop computer. Students in kindergarten, first, second, and third grades had access to Apple iPads in a one student to one device ratio. Students in fourth, fifth, and sixth grades used Apple Macbook Airs in a one student to one device ratio. Additionally, students in third grade had access to a computer cart containing a class set of Apple Macbook Airs, and students in fourth and fifth grades shared Apple iPads with two students sharing one device. Despite the abundance of technology available, teachers' comfort levels and ability to use these resources for student-centered learning varied.

Due to COVID-19, the school transitioned to a distance learning model in March 2020 and continued remote learning for the remainder of the school year. During this time, students and teachers took their school devices home. Google Meet video conferencing software was utilized for instruction. Since the school did not have a learning management system in place, Seesaw was used to share assignments, activities, and notifications in kindergarten through third grade. Google Classroom filled this role in fourth through sixth grades. Classroom schedules were modified to contain only phonics, math, and writing instructional blocks, which were conducted synchronously. A website was created to host videos from the specials teachers guiding students through physical education and music activities or listening to books read aloud. Teachers provided office hours to students in order to answer questions and work with students one-on-one.

The 2020-2021 school year began with face-to-face instruction, and regular school hours resumed. Strict health and safety guidelines were implemented, such as requiring all students, faculty, and staff to wear masks. Members of the school community were asked to quarantine for 14 days if they were exposed to anyone who tested positive for COVID-19. Student devices were sent home each night to ensure students were prepared to learn from home at any time if required. All classrooms were equipped with 360-degree cameras, and the school purchased a Zoom license to support a hybrid instructional model. In this model, students learning from home could join their classroom teacher's Zoom link and follow along with instruction. Seesaw and Google Classroom were again utilized to share assignments with students learning from home.

Participants

Survey Participants. The sample population for the quantitative phase of this study included all 55 faculty members. The school faculty was comprised of 51 female teachers and four male teachers. Teachers ranged in age from 23 years old to 74 years old. Within this range, 31% of the school's teachers were under 30 years old while 33% were over 50 years old. Twenty-three teachers had earned a bachelor's degree, 31 had earned a master's degree, and one had obtained a specialist degree. Levels of experience varied among teachers with 51% having less than five years of experience at the school and 29% having more than 10 years of experience at the school.

The survey was distributed to all 55 faculty members as a Google Form sent via email in February 2020. Respondents could only submit one response, and the form collected email addresses to use for identification of participants who met the criteria for inclusion in the qualitative phase of the study. The survey was open for 10 days, and I sent two reminder emails to faculty members before the survey closed. A total of 29 participants responded to the survey. Twenty-eight of those completed the survey while one teacher responded by saying she did not wish to participate in the study. Therefore, the response rate for the survey was 51%.

Interview Participants. Participants chosen for follow-up interviews and classroom observations were selected using a purposeful sampling method (Merriam, 1998) based on their responses to the survey questions. Purposeful sampling was used for participant selection in order to gather rich, thick descriptions from multiple individuals within this specific school context (Creswell, 2014). Specifically, a maximum variation strategy was employed in order to gather diverse answers to the research questions and understand this phenomenon from multiple perspectives (Bloomberg & Volpe, 2016). Six teachers were selected for participation in terms of their level of technology integration reflected in survey responses. Two teachers were chosen who represented experienced technology integrators that embraced new technologies, expressed confidence in their ability to use technology tools, and provided opportunities for student-centered learning using technology. Two teachers were chosen who represented intermediate technology integrators. These teachers used technology in their classrooms, but usually waited until other teachers had success with the technology before trying it themselves; their instructional methods often relied on technology for teacher-centered learning. Two teachers were chosen who represented novice technology integrators that hesitated to try new technologies, lacked confidence in their ability to use technology tools, and relied on low-level cognitive tasks, such as drill and practice activities, to integrate technology. A detailed introduction to the interview participants is provided in Chapter Four.

Data Collection

Before data collection began, approval was sought from the Institutional Review Board (IRB) at the University of South Carolina to conduct research involving human subjects. An application was completed through the Health Sciences South Carolina website in January 2020. The IRB committee approved the study for exempt review (see Appendix A). In addition, permission to conduct research at the school was sought from the head of school. Approval from the head of school was obtained in November 2019 (see Appendix B).

This mixed methods study collected quantitative and qualitative data to develop an in-depth understanding of participants' beliefs and practices of integrating technology into their classrooms. Quantitative data was collected through a survey in order to understand teachers' and students' uses of technology throughout the school, teachers' beliefs about the role of technology in instruction, and barriers they have experienced when integrating technology. Survey data was used to inform the types of participants selected for the qualitative phase (Creswell, 2014). Qualitative data was collected through interviews and classroom observations on the selected participants (Creswell, 2014). In the end, findings from qualitative data were combined with the quantitative survey data to answer the research questions (Creswell & Plano Clark, 2018). Thus, the use of quantitative and qualitative data provided a more complete understanding of technology integration through rich descriptions of teachers' beliefs and experiences. Table 3.1 shows how each source of data collected aligns with the research questions. The following sections describe each of these data collection methods.

Table 3.1 *Research Questions and Data Sources*

Research Questions	**Data Sources**
RQ1: What are new online teachers' beliefs about the role of technology in teaching and learning at a school for students with dyslexia?	• Survey • Interviews
RQ2: What are new online teachers' perceived barriers to technology integration at a school for students with dyslexia?	• Survey • Interviews
RQ3: How do new online teachers' observed classroom practices align with their stated beliefs about technology?	• Interviews • Observations

Survey Instrument

A survey instrument was adapted from the Survey of Technology Integration and Related Factors (STIR) (Pittman & Gaines, 2015) and the Technology Skills, Beliefs, and Barriers scale (Brush, Glazewski, & Hew, 2008). The survey was sent to all 55 faculty members to collect information about their beliefs regarding the role of technology in teaching and learning, how they use technology, how their students use technology, and what barriers they have encountered when integrating technology. The following paragraphs describe the original survey instrument and the adaptations made to suit the current research study.

The Survey of Technology Integration and Related Factors (STIR) is a 44-item instrument consisting of seven sections. It was designed to collect demographic information from participants as well as levels of access and support to technology, professional development opportunities, participants' beliefs about technology integration, how they use technology themselves and with students, and any barriers they encounter to technology integration. Researchers built upon an instrument created by An and Reigeluth (2012), adding items to distinguish high and low levels of technology integration (Pittman & Gaines, 2015).

Reliability testing was conducted using a pilot group of seven third, fourth, and fifth grade teachers (Pittman & Gaines, 2015). Section two addressing technology access and support and section four addressing teachers' attitudes toward technology in instruction were tested for internal reliability using Cronbach's alpha. The coefficient of reliability was .77 for section two and .78 for section four, indicating a high level of reliability for both sections (Pittman & Gaines, 2015). Internal validity was assessed using feedback from the seven teachers in the pilot group as well as an expert in the field (Pittman & Gaines, 2015). Feedback provided by these individuals was used to confirm consistency among the questions, eliminate ambiguity, and remove potential bias (Pittman & Gaines, 2015).

The Technology Skills, Beliefs, and Barriers scale contains 54 items divided into three sections: Technology Skills, Technology Beliefs, and Perceived Technology Barriers. Brush, Glazewski, and Hew (2008) created the survey to collect data from preservice teachers in order to make curricular recommendations relating to technology preparation in teacher education programs. Reliability testing for each section of the survey resulted in a Cronbach's alpha reliability of .95 for the Technology Skills section, .85 for the Technology Beliefs section, and .81 for the Technology Barriers section (Brush, Glazewski, & Hew, 2008). Construct validity was examined through extensive review of the literature on technology integration as well as review by a panel of teachers and teacher educators with experience in educational technology and technology integration in primary and secondary school settings (Brush, Glazewski, & Hew, 2008).

The STIR was adapted in order to suit the current study (see Appendix C). In addition to using items from the STIR and the Technology Skills, Beliefs, and Barriers scale, extensive literature (Ertmer et al., 2012; Hew & Brush, 2007; Kopcha, 2012) relating to teachers' beliefs and barriers was consulted to identify established concepts (see Table 3.2).

Table 3.2 *Alignment of Adapted STIR and Contributing Sources*

Research Questions	**Survey Section**	**Contributing Source**
RQ1: What are new online teachers' beliefs about the role of technology in teaching and learning at a school for students with dyslexia?	• The Importance of Technology in Teaching and Learning	• STIR • Technology Skills, Beliefs, and Barriers scale
	• Technology use by Students	• STIR
	• Technology use by Teachers	• STIR
RQ2: What are new online teachers' perceived barriers to technology integration a school for students with dyslexia?	• Technology Access and Support	• STIR
	• Barriers to Technology Integration	• STIR • Technology Skills, Beliefs, and Barriers scale • Kopcha (2012) • Hew & Brush (2007) • Ertmer et al. (2012)

The adapted survey contained 66 items divided into six sections. For the purposes of my research, section three of the original survey relating to professional development was removed because it was not relevant to the current study. Within the remaining six sections of the original survey, questions were amended, added, and removed. In the first section collecting demographic data, questions were changed to relate to my school population. For example, additional grade levels were added to represent all of the grades at my school and subject areas were changed to mirror those taught at my school. Section three of the adapted survey was expanded upon with the addition of eleven questions in order to further assess participants' attitudes toward technology integration. Two questions were reworded to increase consistency of sentence construction. Items within section three were also reorganized from the original survey to group statements that relate to beliefs about the role of technology in teaching (items 14-22) and statements that relate to beliefs about the role of technology in learning (items 23-32). Changes in sections five and six involved adding examples of technology tools specific to my school. For example, item 29 asks about students use of online collaboration tools. The following examples were added: Google Drive, Google Hangouts, Skype, Padlet, and Flipgrid. The format of section six relating to the barriers or technology integration was changed in order to elicit a response from participants about each item. In the original survey, participants were asked to rank their top five barriers. In the adapted survey, participants were asked to rate each statement using a Likert scale ranging from (1) Strongly Disagree to (5) Strongly Agree.

Interviews

As a form of data collection, interviews elicit opinions from participants in order to build rich, thick descriptions (Creswell, 2014). Thus, interviews were conducted with the six selected participants in order to develop detailed understanding of teachers' beliefs regarding the role of technology in teaching and learning and barriers they faced when implementing technology. Interviews also served to understand the choices teachers make about using technology and how those uses aligned with their beliefs. By interviewing participants three times over the course of the study, I was able to establish a longitudinal trajectory to identify changes in their beliefs and practices during distance learning. Through maximum variation sampling (Bloomberg & Volpe, 2016), diverse multiple perspectives of technology integration were gleaned from interviews. Interviews were conducted via video conferencing software with all six participants three times during the study. In order to allow adequate time for the interviews, they were scheduled after school hours and on weekends. All interviews were digitally recorded using the software GarageBand. An mp3 file of the interview was uploaded to the website Temi for transcription. Interview transcripts were then downloaded as Microsoft Word documents for analysis. Additionally, I took field notes during interviews to capture nonverbal information, such as facial expressions and body language, which were expanded afterwards (Mack, Woodsong, MacQueen, Guest, & Namey 2005). The following paragraphs outline each interview in further detail.

Initial interview. The first interview with participants lasted approximately 40 minutes and took place before any classroom observations. This interview followed a semi-structured format allowing me to pose the same questions to participants, but also ask clarifying questions as needed (Mertler, 2017). Semi-structured interviews were selected as the best method to elicit participants' beliefs and experiences because they allow participants' unique worldviews to emerge and give the interviewer an opportunity to respond to the situation and new topics that arise (Merriam & Tisdell, 2016). An interview protocol (see Appendix D) was created aligning with the first two research questions. The TPACK framework (Koehler & Mishra,2009), theory of planned behavior (Ajzen, 1991), and technology acceptance model (Davis, 1989) guided the development of interview questions. The interview protocol followed an open-ended format in order to allow participants to freely express their feelings and opinions about technology integration (Mack et al., 2005). Two to eight interview questions were generated for each research question along with probing questions to elicit further elaboration or clarification from participants. Before initial interviews began, the interview protocol was pilot tested with two teachers in order to refine and finalize questions prior to data collection. Based on their feedback, revisions were made to clarify the distinction between technology for teaching and technology for learning. Additionally, one teacher felt the use of the term pedagogical beliefs was too academic for teachers, so that question was revised and elaborated with examples of teacher-centered and student-centered instruction added. The two pilot teachers were not considered for participation in the study. Table 3.3 outlines the interview protocol and alignment to the research questions.

Table 3.3 *Research Question and Initial Interview Question Alignment*

Research Question	**Interview Questions**
RQ1: What are new online teachers' beliefs about the role of technology in teaching and learning at a school for students with dyslexia?	1. Think about how you use technology as a teacher for instruction. In your opinion, what is the role of technology in teaching? a. In what ways does technology help you as a teacher? b. Can you give a specific example? 2. How would you describe the role of technology in learning? a. In what ways does technology help students? b. Can you give a specific example? 3. What do you think are some benefits to using technology in your classroom? a. What are some disadvantages to using technology in your classroom? 4. How would you describe your pedagogical beliefs (e.g., teacher-centered or student-centered)? a. How does technology fit with your pedagogical beliefs?

Research Question	Interview Questions
	b. Can you give me an example from a specific lesson? 5. What are some technology tools you use in your classroom? a. Describe the ways in which you use these tools. b. How do these tools support what you are teaching? c. How do they support student learning? 6. Which technology tool do you use the most in your classroom? a. How frequently do you use that tool? b. Why do you use that tool more than others? c. Give an example of how you use that tool. 7. How would you describe effective technology integration? a. What knowledge and skills are necessary for technology integration to be effective? b. Describe a time when you felt successful integrating technology in your classroom. c. Describe a time when you felt you were unsuccessful integrating technology in your classroom. 8. Has the integration of technology changed your teaching? a. If so, describe how it has changed your teaching? b. If not, why do you think it has not changed your teaching?
RQ2: What are new online teachers' perceived barriers to technology integration at a school for students with dyslexia?	9. What factors motivate you to use technology? a. Do you feel pressure from peers and/or administrators to use technology in your classroom? If so, how much does this affect your decision? b. To what extent do you consider how easy a technology tool is for you to use when deciding to

Research Question	Interview Questions
	implement? c. To what extent do you consider how easy a technology tool is for students to use when deciding to implement? 10. What barriers have prevented you from using technology in your classroom? a. Can you describe a time you were not able to use technology because devices weren't available? b. Can you describe a time you were not able to use technology because you didn't have time? c. Can you describe a time you were not able to use technology because you lacked technical support? d. Can you describe a time you were not able to use technology because you lacked specific technology knowledge and skills? e. Can you describe a time you were not able to use technology because students lacked technology knowledge and skills? f. Can you describe a time you were not able to use technology because you lacked technology-related classroom management knowledge and skills? g. Can you describe a time you were not able to use technology because your beliefs and attitudes about technology prevented you? h. Can you describe a time you were not able to use technology because other teacher's beliefs and attitudes about technology prevented you? i. Can you describe a time you were not able to use technology because administration, parents, or the school community prevented you? 11. What do you think you need to integrate technology more in your classroom?

Second interview. The second interview with participants took place after the initial classroom observations and lasted approximately 30 minutes. The interview followed a semi-structured format (see Appendix E) while also allowing me to ask follow-up questions that arose from observations. Therefore, the follow-up questions asked were unique to each participant and related to the specific technology tools they chose to use in the lessons I observed. This interview addressed the first two research questions by asking participants about their beliefs regarding the role of technology in the classroom and barriers they faced when integrating technology. In addition, this interview addressed research question three by asking targeted questions relating to teachers' stated beliefs and their observed practices. Table 3.4 provides a summary of the interview protocol for the second interview and alignment to the research questions.

Table 3.4 *Research Question and Second Interview Question Alignment*

Research Question	Interview Questions
RQ1: What are new online teachers' beliefs about the role of technology in teaching and learning at a school for students with dyslexia?	1. What factors do you consider when you are planning to integrate technology in your classroom? a. What is your starting point for deciding to use a technology tool (e.g., state standards, learning goals, ease of use, or anything else)? 2. What do you perceive the role of technology to be in distance learning? 3. How has the distance learning environment affected your integration of technology?
RQ2: What are new online teachers' perceived barriers to technology integration at a school for students with dyslexia?	4. What barriers have prevented you from using technology in your classroom? a. Can you think of or describe a time you were not able to use technology because devices weren't available? b. Can you describe a time you were not able to use technology because

Research Question	Interview Questions
	you didn't have time? c. Can you describe a time you were not able to use technology because you lacked technical support? d. Can you describe a time you were not able to use technology because you lacked specific technology knowledge and skills? e. Can you describe a time you were not able to use technology because students lacked technology knowledge and skills? f. Can you describe a time you were not able to use technology because you lacked technology-related classroom management knowledge and skills? g. Can you describe a time you were not able to use technology because your beliefs and attitudes about technology prevented you? h. Can you describe a time you were not able to use technology because other teacher's beliefs and attitudes about technology prevented you? i. Can you describe a time you were not able to use technology because administration, parents, or the school community prevented you? 5. What do you think you need to integrate technology more in your classroom?
RQ3: How do new online teachers' observed classroom practices align with their stated beliefs about technology?	6. In your opinion, how did the lesson I observed represent your typical technology use for your classroom during distance learning? 7. Can you tell me a little about your lesson planning process for that specific lesson? 8. In the lesson I observed, you used _________. Can you explain why you selected that technology tool? a. How did that tool help your instruction/student learning? b. How frequently do you use that tool?

Research Question	Interview Questions
	c. Did you use this tool previously? d. Are there other ways you have used that tool for teaching or learning? Can you describe them? 9. In the lesson I observed, you assigned _________. a. How did it influence student learning in that activity? b. How frequently do you give assignments that require that tool? c. Are there other ways you have used that tool for teaching and learning? Can you describe them? 10. How does your technology use in the lessons I observed align with your pedagogical beliefs? a. Can you give a specific example illustrating how your beliefs are enacted in your practice?

Third interview. The third interview with participants took place after each of them was observed a second time. The interviews lasted approximately 30 minutes and followed a semi-structured format. The interview protocol contained the same questions included in the second interview. However, questions were individualized for each participant based on the technology tools they used in the second lessons I observed.

Classroom Observations

Observations are characteristic of qualitative research and allow researchers to systematically and purposefully take note of behaviors and actions within a specific context as they are occurring (Merriam & Tisdell, 2016). Furthermore, observations can serve to affirm or refute participants' self-reported behaviors (Mack et al., 2005). For this study, classroom observations served to identify how teachers were using technology and whether their stated technology beliefs matched their classroom practices, thus aligning with research question three. Observations also served as reference points to inform the second and third interviews with participants and allowed me to generate questions regarding actions and behaviors I observed (Merriam & Tisdell, 2016).

Classroom observations occurred at two points in this study. The first observation took place after the initial interview with participants and near the end of the 2019-2020 academic school year. The observation was conducted via video-conferencing software due to the school utilizing distance learning. The second observation took place in-person at the beginning of the 2020-2021 academic school year. Participants were asked to provide times they were teaching in order for me to create a schedule for observing each teacher. The observations lasted the length of the class, which varied between 30 minutes and one hour. For classroom observations, I assumed the role of observer as participant. Within this role, my main focus was to gather information regarding technology integration with participation as a secondary focus, and my role as observer was known to the group (Merriam & Tisdell, 2016).

In order to systematically observe specific behaviors and actions, all observations followed a semi-structured format. The use of an observation protocol allowed me to assess the same aspects of technology use in each teacher's classroom while also giving me the flexibility to note other events and interactions observed (Mertler, 2017). A semi-structured observation protocol (see Appendix F) was created using the TPACK theoretical framework and research purpose as a guide. While developing the observation protocol, I examined several existing protocols for possible use, namely the Looking for Technology Integration Instrument (LoFTI), Teaching Dimensions Observation Protocol (TDOP), and ISTE Classroom Observation Tool (ICOT). I decided to design my own protocol based on my desire to record participant behaviors and activities but also add descriptive details to accompany each documented behavior or activity. The aforementioned instruments provided descriptions that helped guide the development of my observation protocol (see Table 3.5).

Table 3.5 *Alignment of Observation Protocol and Contributing Sources*

Research Question	Observation Section	Contributing Source
RQ3: How do new online teachers' observed classroom practices align with their stated beliefs about technology?	• Setting	• ICOT
	• Groups	• ICOT • TDOP
	• Teacher Activity	• ICOT • TDOP
	• Student Engagement	• TDOP
	• Technology Activities	• ICOT • LoFTI
	• Technology Tools Used	• LoFTI

The observation protocol designed for this research consisted of six sections. Section one collected information about the layout of the room, the number of devices, and the number of students. The second section identified how students work (i.e., individual or in a group) during the observation, and the third section addressed the teacher activities, such as lecturing, modeling, and coaching. Section four assessed student engagement in the classroom as high, medium, or low. The fifth and sixth sections of the protocol provided an opportunity to indicate technology activities and technology tools used in the classroom by both teachers and students. In addition, I recorded notes about each activity and each tool used by teachers and students. Systematically recording teacher and student behaviors I observed in class regarding technology use allowed me to determine whether teachers' behaviors matched their stated beliefs about technology integration.

Procedures

This research study was completed in five phases and followed this timeline: Phase 1: Quantitative Data Collection, Phase 2: Quantitative Data Analysis for Participant Selection, Phase 3: Qualitative Data Collection, Phase 4: Quantitative Data Analysis, and Phase 5: Qualitative Data Analysis. Each phase is described in more detail below. Table 3.6 outlines the approximate time each phase took and when it occurred.

Table 3.6 *Research Procedures and Timeline*

Phase	Activities	Duration	Date
Quantitative Data Collection	Sent consent forms and survey to all faculty members	1 week	Feb. 2020
Quantitative Data Analysis for Participant Selection	Analyzed survey results for each respondent Identified experienced, intermediate, and novice integrators Invited six teachers to participate in follow-up interviews and obtain consent Scheduled initial interviews	2 weeks	Feb. 2020
Qualitative Data Collection	Conducted initial interviews Conducted first classroom observations Conducted second interviews Conducted second classroom observations Conducted third interviews	10 weeks [a]	Mar. 2020 May 2020 Sept. 2020
Quantitative Data Analysis	Analyzed survey results for each section and item	2 weeks	Oct. 2020
Qualitative Data Analysis	Transcribed interviews Typed and expanded field notes Conducted member checks	9 weeks	Oct. - Dec. 2020

[a] Qualitative data collection spanned six months, but interviews and observations lasted 10 weeks.

Phase 1: Quantitative Data Collection

Phase 1 of this study began in February 2020. A Google Form was sent to all faculty members at the school. The first page of the form explained the purpose of the research study as well as the voluntary nature of participation and asked for participants' consent. Participants who provided consent advanced to the survey. Once completed, the survey was submitted electronically by participants. The survey was open for 10 days, and I sent two reminder emails to faculty before closing the survey.

Phase 2: Quantitative Data Analysis for Participant Selection

Quantitative data analysis occurred at two points during this study (see Phase 4 for the second point of quantitative data analysis). The initial phase of quantitative data analysis took place after surveys were completed in order to identify participants for the qualitative phase. Items in each survey section were averaged to calculate a mean score for each participant. Then, participants' mean scores from three sections of the survey were averaged together to identify respondents as experienced integrators, intermediate integrators, and novice integrators. Once identified, participants were sent an email inviting them to participate in the qualitative portion of the study. This phase of the study took two weeks to complete.

Phase 3: Qualitative Data Collection

Qualitative data was collected from all six participants through interviews and classroom observations. Collection of qualitative data spanned six months to develop a longitudinal account of teachers' beliefs about technology and technology integration practices in response to disruptions caused by COVID-19. Participants were interviewed three times during the course of this study. Initial interviews took place in March 2020 following the campus closing and transition to distance learning. The second interviews with participants took place in May 2020 after teachers had been instructing students remotely for approximately two months. The third round of interviews occurred in September 2020 when campus reopened and teachers were seeing students in person. The first and second interviews were conducted through Google Meet; the third interview used Zoom. All interviews followed a semi-structured protocol and were audio-recorded using GarageBand software. I also took descriptive field notes during interviews to capture non-verbal information (Mack et al., 2005). Initial interviews lasted 35 to 45 minutes while the second and third interviews lasted approximately 30 minutes. Collection of each round of interview data took two weeks.

Classroom observations were conducted at two points in this study. The first observations occurred in May 2020 and utilized Google Meet to access classrooms. The second observations took place in September 2020 and occurred in person. Observations occurred in classes about different subjects, such as phonics, math, and writing. Each observation lasted the length of the class, which was between 30 and 60 minutes. A semi-structured protocol was used to collect data about which technology tools were in use and how they were being used by teachers and students. Descriptive field notes were also recorded to provide additional details and context for the observation. A total of 12 classroom observations were conducted. Each round of observations took two weeks to complete.

Phase 4: Quantitative Data Analysis

Quantitative data analysis took place after surveys were completed in October 2020. Mean scores and standard deviations were calculated for each survey item as well as each section of the survey. Additionally, during this phase a Cronbach's alpha value was calculated for each section of the survey in order to establish reliability. The quantitative data analysis phase took two weeks to complete.

Phase 5: Qualitative Data Analysis

The final phase of this research study involved analyzing the qualitative data. Within three days of completion, all interviews were transcribed using the web-based program Temi and downloaded as Microsoft Word documents. Field notes from classroom observations were typed into a Microsoft Word document within three days of collection. Transcriptions and field notes were printed out so I could read and write memos in the margins. After that, all data were uploaded to Delve for coding. Data were coded in two cycles, and once completed all codes were downloaded into a Microsoft Excel spreadsheet for further analysis. During this process, I used inductive analysis (Creswell, 2014) in order to classify codes and reduce codes to themes.

Data Analysis

Data analysis is a dynamic and iterative process where insights emerge as the researcher interacts with the data (Merriam & Tisdell, 2016). Three main sources of data were collected for this research study: (a) a survey, (b) interviews, and (c) classroom observations. Thus, data analysis included quantitative and qualitative methods. Table 3.7 shows each data source that was used for this study and the corresponding method of analysis.

Table 3.7 *Research Questions, Data Sources, and Methods of Analysis*

Research Question	**Data Sources**	**Methods of Analysis**
RQ1: What are new online teachers' beliefs about the role of technology in teaching and	• Survey • Interviews	• Descriptive statistics • Inductive

Research Question	Data Sources	Methods of Analysis
learning at a school for students with dyslexia?		analysis
RQ2: What are new online teachers' perceived barriers to technology integration at a school for students with dyslexia?	• Survey • Interviews	• Descriptive statistics • Inductive analysis
RQ3: How do new online teachers' observed classroom practices align with their stated beliefs about technology?	• Interviews • Observations	• Inductive analysis

Rigor and Trustworthiness

In qualitative research, adhering to rigorous methods increases the trustworthiness of findings (Given, 2008). It is necessary to provide evidence that the descriptions of participants and settings as well as the analysis of data "represent the reality of the situations and persons studied" (Bloomberg & Volpe, 2016, p. 77). This is achieved by taking steps throughout the research process to ensure data collection and analysis are accurate and sound (Creswell, 2014). This research study utilized several procedures to ensure rigor and trustworthiness. These included (a) triangulation, (b) prolonged exposure to the research site, (c) peer debriefing, (d) member checks, and (e) an audit trail.

Triangulation

Triangulation of data is a procedure to increase the validity of research through the use of multiple sources of data, multiple perspectives, or multiple methods for the purpose of identifying convergent themes (Creswell, 2014; Shenton, 2004). This research study employed methodological and data triangulation (Denzin, 1973). Data was collected through three methods: a survey, interviews, and classroom observations.

Survey data described the current state of technology integration at the school and identified experienced, intermediate, and novice integrators. Interviews provided self-reported accounts by participants of their technology integration beliefs and experiences which can be compared to their survey responses. Observations served to corroborate interview and survey information by examining participants' actions in the classroom setting. Additionally, data triangulation occurred through the use of a maximum variation sample for the qualitative phase. Examining participants who are purposefully different from each other provided a wide range of perspectives regarding technology integration. Conducting follow-up interviews with participants served to further triangulate the data.

Prolonged Exposure to the Research Site

Prolonged exposure to the research site provides the researcher in-depth understanding of the phenomenon (Creswell, 2014). Seventeen years of experience have afforded me a unique and thorough understanding of the school in which this study took place. Additionally, I have assumed three different roles at the school: classroom teacher, instructional technology specialist, and curriculum and instruction technology coordinator. Through these three roles, I have developed a strong rapport with teachers and in-depth knowledge of the phenomenon under study.

Peer Debriefing

Peer debriefing refers to meetings with an external person or group of people that serve to help the researcher develop ideas through questioning, critiquing, and discussing the research study for the purpose of guidance as well as identification of biases and preferences (Mertler, 2017; Shenton, 2004). Since this research study was completed as part of a doctoral program, my dissertation chair facilitated peer debriefing through feedback and advice offered as this research progressed. Throughout data collection and analysis, codes, categories, and themes were shared electronically with my dissertation chair for review. Weekly video conferences were scheduled with my dissertation chair where I discussed my processes and asked questions. All of my work was shared with my dissertation chair through Microsoft OneDrive so he could review my progress and offer feedback. Our video conferences, emails, and comments within files facilitated discussions with my dissertation chair and allowed him to ask probing questions. These debriefing sessions helped me develop interpretations of the data and verify my findings with accuracy to increase the rigor and trustworthiness.

Member Checks

Member checking involves presenting preliminary findings, descriptions, and themes to participants to check their accuracy (Creswell, 2014). Participants were given the opportunity to state whether the findings accurately capture their experiences or suggest changes that better describe their perspectives (Merriam & Tisdell, 2016). In this research study, participants were emailed a list of preliminary findings containing the themes identified during analysis of the data with short narrative descriptions of each theme. They were asked to respond to the findings with comments and suggestions for changes if necessary. All six participants responded to my email expressing agreement with the themes presented; no comments or suggestions were offered.

Audit Trail

Finally, an audit trail was used as a validation procedure to document "thinking processes that clarify understandings over time" (Creswell, 2017, p. 188). For this research study, the audit trail took two forms: (1) memos written in the margins of interview transcripts and (2) a researcher's journal. After interviews were transcribed, notes of first impressions and repeated patterns were recorded as memos in the margins. I kept a researcher's journal in Google Drive where I recorded thoughts for future interviews, noted patterns and categories as they developed, and reflected on my thinking and processes. These two sources provided evidence and documentation of my decision-making process and the development of interpretations.

Plan for Sharing and Communicating Findings

Results of this action research study were shared with stakeholders at the school in several ways. First, preliminary findings and themes were shared with the six participants during member-checking. A presentation of findings from this study was shared with the academic leadership team and the head of school. The presentation reviewed the purpose of the study and methodology employed but also summarized the results, conclusions, and suggested action steps (Mertler, 2017).

Additional avenues to share findings from this research include local conferences for teachers, such as the Georgia Educational Technology Consortium and Georgia Independent School Association. These annual conferences represent opportunities to report findings that may help other schools trying to integrate technology. In all phases of sharing findings, pseudonyms were used and will continue to be used for participants in order to ensure confidentiality. In addition, when sharing findings outside of the school context, the school name and location will be changed to maintain confidentiality.

CHAPTER 4

ANALYSIS AND FINDINGS

The purpose of this action research was to describe teachers' beliefs about technology integration at a school for students with dyslexia in order to identify action steps the school can take to increase technology use for teaching and learning. This study focused on the following research questions: (a) What are new online teachers' beliefs about the role of technology in teaching and learning at a school for students with dyslexia? (b) What are new online teachers' perceived barriers to technology integration at a school for students with dyslexia? and (c) How do new online teachers' observed classroom practices align with their stated beliefs about technology? Faculty at the school were surveyed to gain an overall understanding of technology integration at the school and address the research questions. Survey responses produced quantitative data that were analyzed using descriptive statistics. Six participants were selected for follow-up interviews and classroom observations. Interview transcripts and field notes from observations were coded for qualitative analysis. The following sections describe the (a) quantitative and (b) qualitative analysis and findings.

Quantitative Data Analysis and Findings

Quantitative analysis of the survey data was conducted to describe technology integration at the school and identify participants for the qualitative phase of the study. Survey data were collected in a Microsoft Excel spreadsheet. Each section of the survey was placed on its own sheet within the spreadsheet for analysis. Descriptive statistics were obtained for each section and each item using the mean and standard deviation functions in Excel. Statistical analysis is outlined in the following sections: (a) survey description and reliability and (b) survey findings.

Survey Description and Reliability

The adapted STIR (Pittman & Gaines, 2015) is a 66-item instrument designed to collect information from teachers about their technology skills, classroom practices, beliefs, and barriers they have encountered when integrating technology. The STIR is divided into six sections. The first section collected demographic information and qualifications, such as teachers' age, years of teaching experience, and highest degree obtained from respondents. The second section consisted of seven statements designed to address respondents' access to technology and the availability of technical support at the school. The third section contained 19 statements addressing respondents' beliefs about the importance of technology in teaching and learning. Respondents used a Likert-type scale to express their agreement with each statement. The fourth section of the survey elicited information from respondents about the frequency of students' use of technology in their classrooms. This section also included an open-ended question where respondents could list additional technologies their students use as well as an item asking teachers to rate their students' level of technology usage. The fifth section addressed teachers' use of technology. It contained seven examples of technology use to which teachers rated their frequency of occurrence. This section also included an open-ended question to list additional technologies they use as well as an item asking teachers to rate their own level of technology usage. The final section of the survey addressed barriers teachers have encountered when integrating technology. It contained 17 statements to which teachers rated their agreement using a five-point Likert-type scale.

Internal consistency was tested using Cronbach's alpha. Results for each section of the survey are shown in Table 4.1. The coefficients of reliability for all sections fell between .75 and .91. According to Gliem and Gliem (2003), the closer the coefficient is to 1.0 the greater the reliability, with alphas greater than .70 considered acceptable and those above .90 considered excellent. Thus, all sections of the survey show acceptable or higher internal consistency.

Table 4.1 *Cronbach's alpha for Adapted STIR*

Survey Section	**Cronbach's alpha**
Technology Access and Support (Items 7-13)	.86
Importance of Technology in Teaching and Learning (Items 14-32)	.91
Technology Use by Students (Items 33-40)	.75
Technology Use by Teachers (Items 41-49)	.84
Barriers to Integration (Items 50-66)	.89

Survey Findings

The STIR was administered via a Google Form which was emailed to all 55 faculty members at the school in February 2020. In total, 28 teachers answered the survey for a response rate of 51%. Some demographic questions were not answered by respondents. Three teachers did not reveal their age, and two teachers did not list how many years they had been teaching. Two open-ended questions asking respondents to list additional technologies used by teachers and students were answered by some but not all respondents. Eleven respondents shared additional technologies used by their students while seven respondents listed additional technologies they used. All other survey items received responses. Survey results are described below and organized into the following sections: (a) demographic information, (b) technology access and support, (c) importance of technology in teaching and learning, (d) technology use by students, (e) technology use by teachers, and (f) barriers to technology integration.

Demographic information. Demographics revealed participants ranged in age from 24 to 69 years old. The average age of participants was 41.4 years old with a standard deviation of 13.76. Eight participants (28.50%) were under 30 years old and 11 participants (39.20%) were over 50 years old. Two male teachers and 26 female teachers participated. Of those, 13 (46.43%) hold bachelor's degrees and 15 (53.57%) hold master's degrees. The average years of overall teaching experience the participants had was 12.15 years with a standard deviation of 8.85. Respondents represented all grade levels at the school and specials teachers. Most of the respondents (n = 21) were phonics teachers; although, as is typical of elementary school teachers, many of them also taught other subjects, such as math, writing, social studies, or science.

Technology access and support. In this survey section, teachers were asked to rate the level of access and support they received on a scale of (1) Poor to (5) Excellent. Reliability testing for this section revealed a coefficient of .84. Cronbach's alpha values for each item if dropped are included in Table 4.2. Based on the results of this measure, the item "The professional development opportunities that my school makes available to me" had a higher value than the overall value for the section. However, it was included in the analysis because it contributed important quantitative data.

Table 4.2 *Cronbach's alpha for Access and Support if Item was Dropped*

Item	**Cronbach's alpha if item was dropped**
The technological hardware available to my students and me for instruction.	.84
The software available to my students and me at my school.	.84
The speed of the available Internet connection at my school.	.84
The reliability of the Internet connection at my school.	.85
The professional development opportunities that my school makes available to me.	.87
The technical support (e.g., troubleshooting) that is available to me.	.84
The instructional support that is available to me.	.82

The mean scores for all items within this section fell between (3) Adequate and (4) Good (see Table 4.3). Overall, teachers felt there was acceptable access to technology and support for technology at the school, and the mean score for statements in this section (M = 4.24, SD = 0.82) aligned with Good. Teachers responded most positively to statements addressing access to hardware and software for faculty and students. Teachers rated the availability of software (M = 4.54, SD = 0.51) slightly higher than the availability of hardware (M = 4.50, SD = 0.57). The lowest rated items in this section related to the Internet connection at the school. The mean score for the reliability of the Internet connection at the school fell within the range of (3) Adequate (M = 3.61, SD = 1.0) while the speed of the Internet connection was rated marginally higher (M = 4.04, SD = 0.84).

Table 4.3 *Descriptive Statistics for Technology Access and Support*

Item	***M***	***SD***
The technological hardware available to my students and me for instruction.	4.50	0.57
The software available to my students and me at my school.	4.54	0.51
The speed of the available Internet connection at my school.	4.04	0.84
The reliability of the Internet connection at my school.	3.61	0.99

Item	*M*	*SD*
The professional development opportunities that my school makes available to me.	4.36	0.68
The technical support (e.g., troubleshooting) that is available to me.	4.21	0.88
The instructional support that is available to me.	4.46	0.79

Importance of technology in teaching and learning. This section of the survey asked teachers to rate their agreement to 19 statements regarding their beliefs about the importance of technology in teaching and learning. Respondents used a five-point Likert-type scale that ranged from (1) Strongly Disagree to (5) Strongly Agree. The reliability coefficient for this survey section was .91, showing high reliability. Table 4.4 displays the Cronbach's alpha values for each item in this section if it was dropped. Based on these measures, all items from this section of the survey were included for analysis.

Table 4.4 *Cronbach's alpha for Importance of Technology in Teaching and Learning if Item was Dropped*

Item	Cronbach's alpha if item was dropped
Technology should be incorporated into the classroom curriculum.	.91
Technology makes my job as a teacher easier.	.91
Incorporating technology into my lessons enhances my instruction.	.90
Using diverse technology (i.e., software, hardware) enriches the repertoire of learning activities in my lessons.	.91
Integrating technology into my instruction successfully increases my motivation to teach.	.90
Knowledge about technology will improve my teaching.	.91
Technology helps me do things with my classes that I would not be able to do without it.	.91
The technology tools I use in lessons depend on the content I am teaching.	.91
Technology facilitates my classroom operations and organization.	.91
Technology skills are essential for my students' success.	.91
Technology helps equip students with technology skills for future use.	.91

Item	Cronbach's alpha if item was dropped
Using technology increases the motivation of students.	.91
Technology increases engagement and collaboration.	.91
Students' use of technology in the classroom is important for knowledge construction.	.90
Using technology with students increases their learning.	.91
A variety of technologies are important for student learning.	.90
Using technology makes learning more meaningful and relevant for students.	.91
Using technology improves student comprehension and promotes higher-level thinking.	.91
Technology can supplement student learning.	.91

The mean score (M = 4.00, SD = 0.80) revealed most teachers agreed with the statements in section three regarding the importance of technology for teaching and learning. Statements in this section addressed both teachers' beliefs about the importance of technology for teaching (items 14-22) and the importance of technology for student learning (items 23-32). Mean scores revealed teachers placed slightly higher importance in the use of technology for teaching (M = 4.07, SD = 0.79) than learning (M = 3.94, SD = 0.80). Means for responses to individual questions in this section ranged between (3) Neutral and (4) Agree. Table 4.5 outlines descriptive statistics for individual items. The strongest agreement was expressed with the statement "Technology should be incorporated into the classroom curriculum" (M = 4.46, SD = 0.58). Teachers also displayed the least variety in their responses to this statement, showing strong consensus that technology should be used in the classroom. Teacher responses showed a high level of agreement with the importance of technology to provide students with skills for future use (M = 4.46, SD = 0.64). Statements regarding the importance of the use of technology for knowledge construction (M = 3.46, SD = 0.79) and improving comprehension and promoting higher level thinking (M =

3.54, *SD* = 0.69) had the lowest mean scores in this section and aligned with (3) Neutral. The greatest variety in teacher responses came from the statement "Integrating technology into my instruction successfully increases my motivation to teach" (*M* = 3.57, *SD* = 1.0) suggesting disparity in how the use of technology motivates teachers.

Table 4.5 *Descriptive Statistics for Importance of Technology in Teaching and Learning*

Item	***M***	***SD***
Technology should be incorporated into the classroom curriculum.	4.46	0.58
Technology makes my job as a teacher easier.	4.04	0.79
Incorporating technology into my lessons enhances my instruction.	3.89	0.69
Using diverse technology (i.e., software, hardware) enriches the repertoire of learning activities in my lessons.	3.96	0.79
Integrating technology into my instruction successfully increases my motivation to teach.	3.57	1.00
Knowledge about technology will improve my teaching.	4.21	0.63
Technology helps me do things with my classes that I would not be able to do without it.	4.21	0.74
The technology tools I use in lessons depend on the content I am teaching.	4.32	0.72
Technology facilitates my classroom operations and organization.	3.96	0.84
Technology skills are essential for my students' success.	3.89	0.88
Technology helps equip students with technology skills for future use.	4.46	0.64
Using technology increases the motivation of students.	4.25	0.75
Technology increases engagement and collaboration.	3.96	0.74
Students' use of technology in the classroom is important for knowledge construction.	3.46	0.79
Using technology with students increases their learning.	3.75	0.70
A variety of technologies are important for student learning.	4.07	0.66
Using technology makes learning more meaningful and relevant for students.	3.82	0.67
Using technology improves student comprehension and promotes higher-level thinking.	3.54	0.69
Technology can supplement student learning.	4.14	0.97

Technology use by students. In this section of the survey, teachers were asked to rate their students' technology usage for classroom-related activities using a Likert-type scale that ranged from (1) Nonexistent to (5) Excellent. Mean responses for this question rated students' technology usage as (3) Average (*M* = 3.25, *SD* = 0.78). Teachers were also asked to rate the frequency of different technology tools used by their students for classroom activities according to the following scale: (1) Not at all, (2) Once per month or less, (3) Once per week, (4) Several times per week, or (5) Daily. Reliability testing for this section produced a Cronbach's alpha value of .75. Testing of individual items in this section are shown in Table 4.6. Despite the item "Graphics programs (draw/paint, photo editing, video, etc.)" being higher than .75, it was included in the analysis to provide quantitative data on student use of technology.

Table 4.6 *Cronbach's alpha for Technology Use by Students if Item was Dropped*

Item	**Cronbach's alpha if item was dropped**
Word processors (typing)	.67
Internet research	.70
Drill and practice/ Learning games	.72
Presentation software (Google Slides, PowerPoint, etc.)	.74
Google Drive, Google Hangout, Skype, Padlet, Flipgrid, etc.)	.68
Graphics programs (draw/paint, photo editing, video, etc.)	.77

The overall mean score for this section was 2.70 with a standard deviation of 1.26. This revealed considerable variation in students' technology use for class-related activities. Table 4.7 outlines descriptive statistics of individual items within this section. Based on mean value, the most frequently used technology by students was drill and practice/learning games (*M* = 2.96, *SD* = 1.17). The majority of teachers (*n* = 19) stated students used these at least once per week. Word processing (*M* = 2.93, *SD* = 1.46) and presentation tools (*M* = 2.93, *SD* = 1.30) were also used almost weekly by students. However, there was significant disparity among responses.

Table 4.7 *Descriptive Statistics for Technology Use by Students*

Item	***M***	***SD***
Word processors (typing)	2.93	1.46
Internet research	2.21	0.88
Drill and practice/ Learning games	2.96	1.17
Presentation software (Google Slides, PowerPoint, etc.)	2.93	1.30
Online collaboration tools (Google Drive, Google Hangout, Skype, Padlet, Flipgrid, etc.)	2.82	1.49
Graphics programs (draw/paint, photo editing, video, etc.)	2.32	1.02

A closer look at the frequency of each technology tool revealed variety in how often students used them (see Table 4.8). Teacher responses indicated online collaboration tools (n = 5) were used daily more than any other tools. However, teachers reported students used word processors (n = 8), drill and practice/learning game (n = 8), and presentation software (n = 8) several times per week. Conversely, the same number of teacher (n = 8) reported students never use word processors. The variation in responses within this section could be due to students' age or the subject matter taught. For example, students in kindergarten through second grade do not learn keyboarding and are less likely to use word processors. Five respondents who answered (1) Never to using word processors were teachers in kindergarten, first, or second grade. Three respondents who answered (1) Never were specials teachers who do not use word processors with students during their classes.

In this section of the survey, teachers were provided an opportunity to list other technology that students use on a regular basis. Eleven teachers responded to this item with the following technologies: Braining Camp math manipulatives, Google Classroom, Seesaw, Scratch Jr., Popplet, Scholastic Online Magazine, Learning Ally, Read Naturally, Epic, Smartboard, Pear Deck, Nearpod, and Kahoot.

Table 4.8 *Frequency of Technology Use by Students*

Item	**1 = not at all**	**2 = once per month or less**	**3 = once per week**	**4 = several times per week**	**5 = daily**
Word processors (typing)	8	2	6	8	4
Internet research	5	15	5	3	0
Drill and practice/ Learning games	4	5	9	8	2
Presentation software (Google Slides, PowerPoint, etc.)	5	6	6	8	3
Online collaboration tools (Google Drive, Google Hangout, Skype, Padlet, Flipgrid, etc.)	7	7	3	6	5
Graphics programs (draw/paint, photo editing, video, etc.)	5	14	5	3	1

Technology use by teachers. In this section, teachers were asked to rate the frequency with which they used technology tools for school-related activities using a Likert-type scale ranging from (1) Not at all to (5) Daily. Testing showed high reliability for this section of the survey with an alpha of .84. Detailed reliability analysis of this section is provided in Table 4.9. Since all items maintained a high alpha value when dropped, all were included in the analysis.

Table 4.9 *Cronbach's alpha for Technology Use by Teachers if Items were Dropped*

Item	**Cronbach's alpha if item was dropped**
Internet research for planning and ideas	.83
Organization/tracking software for classroom management	.81
Communication with parents/students (email, blog, text, etc.)	.82
Presentations during instructions (Google Slides, PowerPoint, etc.)	.83
Multimedia enhancements during instruction (videos, simulations, etc,)	.81
Website creation or maintenance (e.g., class website)	.82
Providing individualized or remedial instruction	.83

The mean score for this section fell between (3) Once per week and (4) Several times per week (M = 3.26, SD = 1.49), revealing teachers use some of the technology tools frequently. A summary of mean scores for each item within this section is provided in Table 4.10. Results revealed Communication with Parents/Students (*M* = 4.32, *SD* = 1.24) was the most frequently used technology and Website Creation or Maintenance (*M* = 2.14, *SD* = 1.33) was the least used technology. The use of Organization/tracking software for classroom management showed the most disparity among respondents (*M* = 3.18, *SD* = 1.70).

Table 4.10 *Descriptive Statistics for Technology Use by Teachers*

Item	***M***	***SD***
Internet research for planning and ideas	3.46	1.53
Organization/tracking software for classroom management	3.18	1.70
Communication with parents/students (email, blog, text, etc.)	4.32	1.24
Presentations during instructions (Google Slides, PowerPoint, etc.)	3.71	1.15
Multimedia enhancements during instruction (videos, simulations, etc,)	3.36	1.19
Website creation or maintenance (e.g., class website)	2.14	1.33
Providing individualized or remedial instruction	2.61	1.34

Of note is the significant variation between responses to all items in this section. Therefore, a closer examination of the frequency of individual technology items by teachers was warranted (see Table 4.11). Analysis revealed most teachers (*n* = 23) communicated with parents or students several times a week or daily, and all but one teacher communicated with parents or students some of the time. The majority of teachers (*n* = 21) used presentations, such as Google Slides, during instruction at least several times per week or daily. Internet research for planning and ideas and multimedia enhancements during instruction were also used frequently by most teachers (*n* = 17). Conversely, nearly half of the teachers (*n* = 13) did not create or maintain a website at all.

Table 4.11 *Frequency of Technology Use by Teachers*

Item	**1 = not at all**	**2 = once per month or less**	**3 = once per week**	**4 = several times per week**	**5 = daily**
Internet research for planning and ideas	4	6	1	7	10
Organization/tracking software for classroom management	9	1	3	6	9
Communication with parents/students (email, blog, text, etc.)	1	2	2	5	18
Presentations during instruction (Google Slides, PowerPoint, etc.)	2	3	2	15	6
Multimedia enhancements during instruction (videos, simulations, etc,)	3	4	4	14	3
Website creation or maintenance (e.g., class website)	13	5	5	3	2
Providing individualized or remedial instruction	7	9	2	8	2

In addition to rating the frequency of their technology use, teachers were asked what other tools they used on a regular basis. Seven teachers responded to this item. Technology tools identified included some that were subject specific, such as Music Play and Guitar Tuna, and some that were specific examples which fit into the categories provided in the section items, such as Google Slides. Several tools named were used by both teachers and students, such as Read Naturally, Pear Deck, and Nearpod. Other technologies included Blend Space, Popplet, Smart Notebook, Mystery Science, IXL, and Quizlet. Teachers were also asked to describe their level of technology integration as (1) Nonexistent, (2) Limited, (3) Average, (4) Above Average, or (5) Excellent. The mean for this item (M = 3.39, SD = 0.74) revealed most teachers feel their level of technology integration is (3) Average. Interestingly, one teacher rated her level as (5) Excellent while three teachers rated their levels as (2) Limited. All other responses were (3) Average or (4) Above Average.

Barriers to technology integration. To identify barriers teachers encountered when integrating technology, teachers were asked to rate their agreement with 17 statements using a Likert-type scale ranging from (1) Strongly Disagree to (5) Strongly Agree. The reliability coefficient for this survey section was .89, revealing high reliability. Table 4.12 shows the Cronbach's alpha values for each item in this section if it was dropped. Based on these measures, the item "Teaching students content knowledge should take priority over teaching them technology skills" was found to have an alpha value higher than the section value when dropped. However, it was included in the analysis because it provided valuable quantitative data about barriers teachers faced.

Table 4.12 *Cronbach's alpha for Barriers to Technology Integration if Items were Dropped*

Item	**Cronbach's alpha if item was dropped**
Developing lessons plans that incorporate technology takes too much of my time.	.89
Learning to use technology for instruction is time-consuming.	.88
Teaching students how to use technology take much of classroom time.	.88
There is a lack of available computers/hardware.	.89
There is a lack of professional development opportunities related to technology use.	.89
I do not have enough mentoring to help me increase my knowledge about technology.	.89
The technology-related professional development that is provided does not apply to my learning environment.	.89
There is a lack of administrative encouragement/support.	.89
There is a lack of IT personnel to help with technology issues.	.89
I lack knowledge about technology.	.88
I lack knowledge about ways to integrate technology into the curriculum.	.88
There is too much material to cover.	.88

Item	Cronbach's alpha if item was dropped
I do not see a need to use technology for learning when my traditional classroom practices continue to work.	.89
Technology is not essential to teaching and learning.	.89
Teaching students content knowledge should take priority over teaching them technology skills.	.90
Technology-based activities use more class time than traditional methods of instruction.	.88
Most students have so many other needs that technology use is a low priority.	.88

Results for items in this section were divided into first-order barriers and second-order barriers for analysis based on Ertmer's (1999) classification of first-order barriers being external and second-order barriers being internal. Descriptive statistics for these items are included in Tables 4.13 and 4.14. Analysis revealed that overall teachers experienced slightly more second-order barriers (M = 2.60, SD = 1.16) than first-order barriers (M = 2.39, SD = 1.22).

The most significant internal barrier was expressed in the statement "Teaching students content knowledge should take priority over teaching them technology skills" (M = 3.12, SD = 1.13). There was significant variation in teachers' responses to the statement "Technology-based activities use more class time than traditional methods of instruction" (M = 3.00, SD = 1.64), showing some teachers do not believe technology-based activities take more time than traditional instructional methods. The most consensus regarding any item in this section was around the statement "Technology is not essential to teaching and learning" (M = 1.89, SD = 0.69) to which most teachers disagreed.

Table 4.13 *Descriptive Statistics for Second-Order Barriers*

Item	*M*	*SD*
I lack knowledge about technology.	2.64	1.22
I lack knowledge about ways to integrate technology into the curriculum.	2.57	1.14
There is too much material to cover.	2.68	1.28
I do not see a need to use technology for learning when my traditional classroom practices continue to work.	2.07	1.09
Technology is not essential to teaching and learning.	1.89	0.69
Teaching students content knowledge should take priority over teaching them technology skills.	3.12	1.13
Technology-based activities use more class time than traditional methods of instruction.	3.00	1.64
Most students have so many other needs that technology use is a low priority.	2.82	1.06

Teachers expressed considerable agreement with two statements relating to time as a barrier to technology use. Mean scores for the statements "Learning to use technology for instruction is time-consuming" (M = 3.36, SD = 1.06) and "Teaching students how to use technology take much of classroom time" (M = 3.54, SD = 1.10) revealed the time it takes to learn technology and teach it to students was a barrier to integration. Interestingly, teachers did not agree with the statement "Developing lesson plans that incorporate technology takes too much of my time" (M = 2.64, SD = 1.16). Teachers showed the least agreement with the statement "There is a lack of available computers/hardware" (M = 1.71, SD = 0.81), indicating access to technology was not a significant barrier at the school.

Table 4.14 *Descriptive Statistics for First-Order Barriers*

Item	*M*	*SD*
Developing lesson plans that incorporate technology takes too much of my time.	2.64	1.16
Learning to use technology for instruction is time-consuming.	3.36	1.06
Teaching students how to use technology take much of	3.54	1.10

Item	*M*	*SD*
classroom time.		
There is a lack of available computers/hardware.	1.71	0.81
There is a lack of professional development opportunities related to technology use.	1.96	0.92
I do not have enough mentoring to help me increase my knowledge about technology.	2.21	1.20
The technology-related professional development that is provided does not apply to my learning environment.	2.21	1.10
There is a lack of administrative encouragement/support.	1.89	1.17
There is a lack of IT personnel to help with technology issues.	1.96	1.04

Qualitative Findings and Interpretations

Quantitative survey results were used to identify six participants for the qualitative phase of the research study. Qualitative data were collected through interviews and classroom observations with the six participants. Interview data allowed me to elicit participants' beliefs about the use of technology for teaching and identify barriers they encountered when integrating technology. Observations gave me an opportunity to witness teachers' experiences using technology and their classroom practices. These observations were compared with participants' stated beliefs to determine if they aligned. Participants were interviewed three times following a semi-structured protocol and observed twice. The following sections describe (a) participant selection, (b) qualitative data analysis, and (c) presentation of findings.

Participant Selection

Teachers were identified as experienced, intermediate, or novice technology integrators through analysis of survey data. Mean scores were calculated for three sections of the survey: The Importance of Technology in Teaching and Learning, Technology Use by Students, and Technology Use by Teachers. Scores from these three sections were averaged, and teachers were sorted in descending order based on these averages. From this list, quartiles were identified. Ranges for quartiles are listed in Table 4.15.

Table 4.15 *Range of Mean Score Quartiles for Teacher Responses*

Quartile	**Range**
4th	4.49 - 3.83
3rd	3.70 - 3.41
2nd	3.30 - 2.92
1st	2.87 - 2.01

Note. The range for possible responses was 0 to 5.

Teachers at the upper end of the fourth quartile were identified as experienced integrators. Teachers at the lower end of the first quartile were identified as novice integrators. Teachers near the upper end of the second quartile and lower end of the third quartile were designated intermediate integrators. Once quartiles were distinguished, two teachers from the fourth quartile, two teachers from the first quartile, one teacher from the second quartile, and one teacher from the third quartile were invited via email to participate in the qualitative phase of the study. Five teachers responded agreeing to participate. One teacher from the third quartile never responded to my email, so I returned to the list of mean scores and identified another participant from the same quartile. Upon receiving my invitation, that teacher agreed to participate in the study. Table 4.16 shows participants' mean scores for sections three, four, and five of the survey and their designation as experienced, intermediate, or novice integrator. Pseudonyms have been used in place of participants' real names to protect their identity.

Table 4.16 *Mean Scores for Participants' Responses to Survey Sections Three, Four, and Five*

Pseudonym	**Integrator Designation**	**Mean Score**
Amelia	Experienced	4.20
Rachel	Experienced	4.02
Charlotte	Intermediate	3.42
Emma	Intermediate	3.30
Olivia	Novice	2.22
Sophia	Novice	2.05

All six participants selected for the qualitative phase were female. They represented a range of grade levels with two teachers from first grade, two teachers from third grade, and two teachers from fourth grade. Since the study spanned two academic school years, one teacher changed grades during the study and moved to second grade. Three teachers had obtained a master's degree and three had obtained a bachelor's degree. The average age of participants was 36 years old (SD = 13.24). Teachers had varying levels of teaching experience with the most experienced teacher accruing 17 years and the least experienced teacher having worked only two years. Three teachers were new to the school during the 2019-2020 school year while one teacher had been teaching at the school for 15 years. All of the teachers taught several different subjects (see Table 4.17). To protect participants' privacy, I have not included descriptive information that would compromise their identities.

Table. 4.17 *Subjects Taught by Participants*

Pseudonym	**Grade**	**Integrator**	**Subjects Taught**
Sophia	1st	Novice	Phonics, math, writing, social studies, science

Pseudonym	Grade	Integrator	Subjects Taught
Charlotte	1st	Intermediate	Phonics, math, writing, social studies
Olivia	3rd	Novice	Phonics, math, social studies
Emma	3rd	Intermediate	Phonics, math, writing, social studies, science
Amelia	4th	Experienced	Phonics, math, social studies
Rachel	4th	Experienced	Math, writing, social studies, science

Qualitative Data Analysis

Qualitative data sources included three interviews and two observations with each participant. Qualitative interview data were collected using GarageBand. Each interview was exported as an .mp3 file and uploaded to the website Temi for transcription. Temi created a transcript, which I compared to the original audio recording and edited for accuracy. Once interviews were reviewed in Temi, I downloaded the files as Microsoft Word documents. Observations were typed and expanded upon in Microsoft Word documents. Then, all Microsoft Word files of interviews and observations were uploaded to the website Delve to conduct first-cycle coding.

Thematic analysis (Braun & Clarke, 2006) was applied to analyze qualitative data in order to reveal themes within the data. Data were analyzed by reviewing interviews and field notes to assign codes to relevant information. Codes are words or short phrases "that symbolically assign a summative, salient, essence-capturing, and/or evocative attribute for a portion of language or visual data" (Saldaña, 2016, p. 4). The goal of coding is to identify patterns within the data, categorize information, and generate themes (Bogdan & Biklen, 1998). Table 4.18 summarizes the amount of qualitative data collected and the total number of codes generated.

Table 4.18 *Summary of Qualitative Data Sources*

Types of Qualitative Data Sources	**Number**	**Total Number of Codes Applied**
Initial interview transcripts	6	867
First observation field notes	6	157
Second interview transcripts	6	671
Second observation field notes	6	140
Third interview transcripts	6	679
Totals	30	2,514

Qualitative analysis of the data was completed in two cycles. The first cycle involved coding the most essential data (Creswell, 2014). This cycle consisted of three rounds of coding utilizing four different methods: in vivo, descriptive, process, and values coding (Saldaña, 2016). The second cycle served to reorganize and reanalyze the data in order to generate categories and eventually themes (Saldaña, 2016). This cycle utilized two rounds of pattern coding to reexamine the data. Throughout the data analysis process, I recorded analytic memos to document thoughts, ideas, emerging categories, and questions. The following sections describe first-cycle and second-cycle coding methods in more detail.

First-cycle methods. To conduct first-cycle coding of the data, all Microsoft Word files of interviews and observations were uploaded to the website Delve. Data were analyzed and codes were applied to meaningful units of text (Bogdan & Biklen, 1998). The first cycle of coding consisted of three rounds. The first round employed in vivo and descriptive coding; the second round utilized process coding; and the third round used values coding. Within Delve, I created three different projects for the three rounds of coding. Multiple methods of coding were selected in order to address all the research questions. Table 4.19 shows which methods addressed each research question.

Table 4.19 *Coding Method and Research Question Alignment*

Research Questions	**Data Sources**	**Coding Methods Used**
RQ1: What are new online teachers' beliefs about the role of technology in teaching and learning at a school for students with dyslexia?	• Survey • Interviews	• In vivo • Values
RQ2: What are new online teachers' perceived barriers to technology integration at a school for students with dyslexia?	• Survey • Interviews	• In vivo • Process • Values
RQ3: How do new online teachers' observed classroom practices align with their stated beliefs about technology?	• Interviews • Observations	• In vivo • Descriptive • Process

In vivo coding. For the first round, I employed in vivo coding for the interviews and descriptive coding for the observations. Two different coding methods were used for this first round to connect participant's observations and interviews and then to develop each individual story as a whole. This also established an account of participants' experiences with and perceptions of technology integration at a specific point so as to identify changes over time. It was important for me to have participants describe their technology integration experiences and beliefs using their own words. In vivo coding is appropriate for virtually all qualitative studies, but particularly those that want to honor participants' voices (Saldaña, 2016). Descriptive coding was used to analyze observations during this round since it provides a focused filter for analyzing data and builds a foundation for future rounds of coding (Miles, Huberman, & Saldaña, 2020). I organized the data in Delve by participant and coded all data points (e.g., three rounds of interviews and two rounds of observation) for one participant before moving on to the next participant. Specifically, I coded the first interview, first observation, second interview, second observation, and then the final interview. As I analyzed the data, I assigned codes to meaningful units of text and placed in vivo codes in quotation marks to separate them from descriptive codes. In long sentences, several codes were assigned. For example, in Figure 4.1 the first sentence generated four in vivo codes.

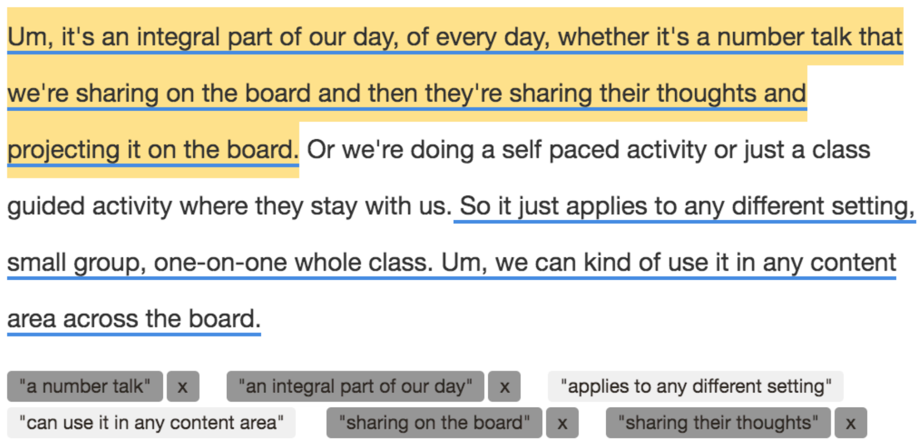

Figure 4.1. In vivo coding in Delve.

As I read through participant observations, I identified meaningful units of text and assigned descriptive codes. For example, the sentence "She asked them to play Quizlet Live two times before they could leave class" was coded as *Drill and Practice Activity*. This first round of coding generated 1,414 in vivo codes and 191 descriptive codes.

Process coding. The second round of coding utilized process coding (Bogdan & Biklen, 1998). This method uses gerunds as codes to capture actions in the form of observable activities as well as conceptual action within the data (Miles, Huberman, & Saldaña, 2020). This method was selected for the study to explicitly tell the story of how participants were using technology as indicated by their actions (e.g., gerunds) and how their use changed over time. As with the previous round of coding, I analyzed each participant's five data points and coded meaningful units of text before going on to the next participant. Process coding captures human processes that Saldaña (2016) notes "imply action intertwined with the dynamics of time" (p. 111). For example, the statement from Olivia "this used to be a paper-pencil activity, and with COVID I was looking for ways to move away from this" was assigned the process code *Adapting Paper and Pencil Activity*, which encapsulated her change in behavior to create an activity using Seesaw instead of relying on paper and pencil. The use of gerunds also helped capture the actions that occurred during observations. For example, the statement "She used her Explain Everything presentation to model how to divide 2 by 4 people (giving each person 50 cents)" was coded as *Using Technology to Model*. During this round, some codes were applied repeatedly. For instance, the code *Collecting Formative Data* was assigned 11 times and the code *Providing a Visual* was assigned 13 times. In total, 312 process codes were assigned to the data.

Values coding. Values coding was conducted for the third round in this cycle. Values coding was a particularly appropriate method for my research because it captures participants' "values, attitudes, and beliefs, representing his or her perspectives and worldview" (Saldaña, 2016, p. 131). This method allowed me to understand the aspects of teaching that participants valued, their attitudes toward technology, their beliefs about the role of technology in teaching and learning, and how these changed over the course of the study. As such, codes were labeled with a B, V, or A to represent participants' beliefs, values, and attitudes (see figure 4.2).

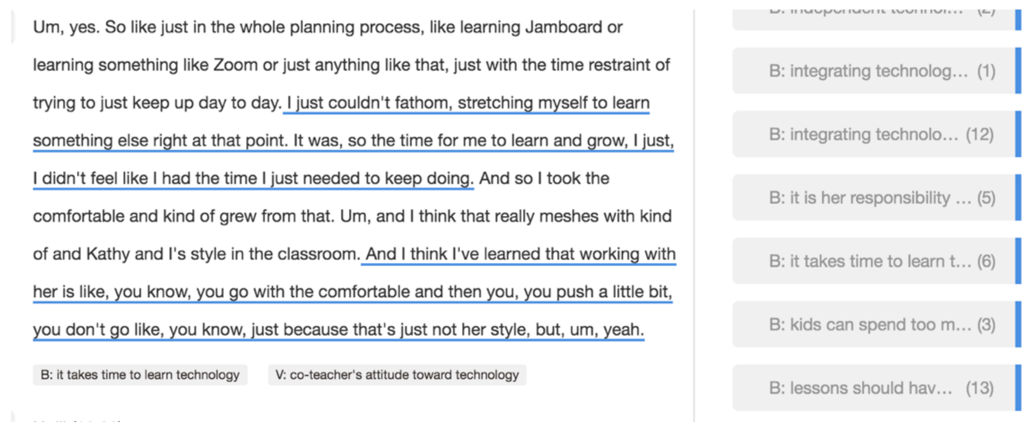

Figure 4.2. Values coding in Delve.

Codes labeled as values related to the importance participants attributed to themselves, other people, things, or ideas (Miles, Huberman, & Saldaña, 2020). For example, *Accessibility* and *Collaboration* were two codes that were identified as representing values. Statements that reflected the way participants felt about themselves, other people, things, or ideas were coded as attitudes (Miles, Huberman, & Saldaña, 2020). Some codes identified as attitudes were *Resilient*, *Enthusiastic*, and *Critical*. Saldaña (2016) identifies beliefs as "part of a system that includes our values and attitudes, plus our personal knowledge, experiences, opinions, prejudices, morals, and other interpretive perceptions of the social world" (p. 132). Statements expressing how participants thought and felt were coded as beliefs. For example, Rachel's statement "I think [technology] is a really good tool to be able to engage kids and make [the content] a little bit more applicable to their lives and a little more interesting" was coded as the belief *Technology Engages Students*. Some codes were used repeatedly during this round. For example, the attitude *Frustration* and the belief *Integrating Technology Takes Time* were each applied 12 times. I worked through the data, analyzing all the data points and assigning codes to meaningful units of text for one participant at a time. This round generated 597 values codes.

Peer debriefing. After coding one participant in each round, my dissertation chair and I engaged in peer debriefing (H. Tang, personal communication, October 6, 2020). He reviewed the codes, questioned what some of them meant, offered feedback, and provided guidance as I moved forward. For example, when reviewing descriptive codes from observations, we discussed the code *Teacher was Prepared*. After explaining what I meant by this code and how it related to the observation, the code was changed to *Pre-made Presentation Using Technology*. When I completed each round of coding, I reviewed all the codes generated during that round. Some codes were changed to more accurately represent the data or re-worded for consistency. For instance, the code *Considering How User-Friendly Tool Is* was re-worded to *Choosing Technology That's User-Friendly* because this code had been applied to several segments of text. While reviewing the codes, I made notes in my researcher's journal to document thoughts I had about the data, emerging categories, patterns I was identifying in the data, and questions that arose. For example, one entry from November identified *Balancing Technology* as an emerging theme and noted several teachers were concerned with striking a balance between using technology and using multisensory methods.

Transition to the second cycle of coding. To transition to the second cycle of coding, I exported all coded transcripts in Delve as Microsoft Excel files. I reviewed all the codes generated in the first cycle and thought about how they answered my research questions to begin visualizing the data (Bogdan & Biklen, 1998). I used the color fill tool in Microsoft Excel to highlight codes that seemed related in order to give structure to the data (see Figure 4.3).

So my, um, you know, ideally it is, um, student-centered, but often it is also teacher-centered because we are trying to get something across.	""ideally [beliefs are] student-centered""	""often teacher-centered to get something across""	
Um, sometimes it seems to be, you know, that self discovering is, is a great thing, but it's more time consuming often than if you, if it's more teacher-oriented where you feel like I need them to know this and I need to know, them to know this pretty fast.	""it's more time-consuming than teacher-oriented""	""need them to know this fast""	""self-discovering is a great thing""
And I'm such a visual learner myself and such a motor--.	""a visual learner""		
You know, I find, I find that motor component so important that my thinking is always how is the motor component supporting the, the learning.	""how the motor component support learning""	""motor component is important""	
So I always try to put a lot of multisensory aspects into my lessons, meaning, um, you know, hearing, seeing spelling.	""put multisensory aspects into lessons""		
And so that, that often drives my lesson plans.	""that drives lesson plans""		
That they need to have a strong visual.	""[students] need a strong visual""		
And after they have the strong visual, they need to hear it, but they also need to be doing something as a motor component where they write.	""need a motor component""	""need to hear it""	
And uh, but now since every child has an iPad, I think that's totally, absolutely great.	""absolutely great""	""every child has an iPad""	
So this morning, for example, I got really frustrated in math.	Barrier - Time: ""got frustrated in math""		
And, um, it took him a while to sign into Braning camp with the app.	Barrier - Time: ""took a while to sign into Braining Camp""		

Figure 4.3. Coloring related codes in Microsoft Excel.

Second-cycle methods. The second cycle of coding consisted of pattern coding, which involves arranging similarly coded data into categories that attribute meaning (Saldaña, 2016). To prepare the data for this cycle, I created one Microsoft Excel spreadsheet for each data point from each participant. To keep track of which participant and which data point the codes originated, I created a color-coded system. I used the color fill tool in Microsoft Excel to assign each participant a color. Then, each data point from that participant was assigned a shade of that color (see Figure 4.4).

Participant	Data point	File name & color
Amelia	interview 1	AI1
	interview 2	AI2
	interview 3	AI3
	observation 1	AO1
	observation 2	AO2
Rachel	interview 1	RI1
	interview 2	RI2
	interview 3	RI3
	observation 1	RO1
	observation 2	RO2
Emma	interview 1	EI1
	interview 2	EI2
	interview 3	EI3
	observation 1	EO1
	observation 2	EO2
Charlotte	interview 1	CI1
	interview 2	CI2
	interview 3	CI3
	observation 1	CO1
	observation 2	CO2
Olivia	interview 1	OI1
	interview 2	OI2
	interview 3	OI3
	observation 1	OO1
	observation 2	OO2
Sophia	interview 1	SI1
	interview 2	SI2
	interview 3	SI3
	observation 1	SO1
	observation 2	SO2

Figure 4.4. Color-coding of data points in Microsoft Excel.

Within each spreadsheet, I created four different sheets. One the first sheet, I copied all the in vivo or descriptive codes for that data point. On the second sheet, I copied all the process codes, and on the third sheet, I copied all the values codes. I used the fourth sheet as my workspace to record pattern codes. I began by reading through the values codes. As I noticed related codes, I copied them to the fourth sheet and organized them in a column, leaving the top row blank. I then moved to the process codes and followed the same pattern: I copied related codes onto the fourth sheet and organized them in a column beside values codes that were related. Finally, I reviewed the in vivo codes or descriptive codes, depending on the data point, and copied related codes to the fourth sheet. Utilizing Microsoft Excel for this stage of coding allowed me to easily move codes from one column to another if needed. Once I had reviewed all the codes for that data point, I looked over the codes that I had grouped together on the fourth sheet. I created a pattern code for the related codes, which I typed in capital letters in the first row of the fourth sheet. I also included a narrative sentence to help me remember how I arrived at the code and what it meant. Then, I filled the top row with the color assigned to that participant and data point. Figure 4.5 provides a sample of the pattern coding for one data point.

MULTISENSORY COMPONENT IS IMPORTANT: She believes lessons should have a multisensory component.			ADAPTING INSTRUCTION TO USE TECHNOLOGY FOR MULTISENSORY COMPONENT: She is rethinking how she can adapt paper/pencil activities to ones that use technology.			SHIFTING ATTITUDE TOWARD TECHNOLOGY: Recognizes the need for technology that she didn't see before.		
B: lessons should have multisensory component	providing a visual	""finding that multisensory component""	B: paper and pencil is more multisensory	adapting pencil and paper activity	""looking for ways to move away [from paper pencil]""	B: technology is essential for distance learning	starting to integrate technology more	""have to find an activity kids can do online""
V: providing a visual	incorporating multisensory activities	""[students] need a strong visual""	V: balancing technology use and pencil/paper	balancing technology and hands-on methods	""able to make it visible on the Smartboard""	B: need to be able to use technology in teaching	using technology more in other subjects	""[hybrid learning] makes technology more necessary""
V: learning goal		""need a motor component""	A: enthusiastic	planning technology last	""[students] following along on Seesaw""	A: openness		""didn't see the need before""

Figure 4.5. Example of pattern coding in Microsoft Excel.

After I finished pattern coding all the data points for one participant, I copied all the pattern codes into a new spreadsheet. This became my master spreadsheet where all participants' pattern codes were saved. Each participant was given a different sheet within that spreadsheet. To further analyze the data, I printed each page of this spreadsheet and cut them out in order to arrange the codes. Figure 4.6 shows all the pattern codes printed and arranged on a table.

Figure 4.6. Codes arranged by participant.

Once the codes were cut, I began organizing all the codes for each participant. As I worked, I made notes detailing a description of her experience with technology integration. This step helped me better understand the individual patterns for each participant. For example, when arranging the codes by participant, it was clear that Sophia, a novice integrator, experienced more barriers than any other participant. After organizing codes by participant, I examined codes across participants. To do this, I combined all codes and began to group those that seemed related. I used sticky notes to write down categories as they emerged and placed these notes above the related codes. During this process, I would step away from my work and come back later to see if I agreed with the codes and categories. Working in this manner was helpful as I changed categories a few times and divided some categories into smaller, more specific categories. For example, one early category was Shifting Attitudes Toward Technology. As I reviewed the codes organized into this category, I realized some participants were seeing benefits to technology while others were identifying drawbacks. I decided to divide this category into the two more specific categories Recognizing the Benefits of Technology and Concern of Overreliance on Technology. During this time, I also diligently took notes in my researcher's journal as themes began to emerge. Figure 4.7 shows the codes arranged in categories.

Figure 4.7. Codes arranged in categories.

The final step in analyzing my data was to generate themes using pattern coding (Saldaña, 2016). I stepped away from the work I had done creating categories for a few days to keep a clear mind when eliciting the themes. Then, I revisited the categories as well as the notes I had recorded in my journal. Several themes became apparent at this point. Once I settled on a theme, I wrote it down on an index card and placed it above the categories and codes. During this process, I met with my dissertation chair to discuss the emerging themes (H. Tang, personal communication, December 1, 2020). I explained how I had arrived at the themes, and he asked clarifying questions. In our initial discussion of the themes, he encouraged me to continue examining two of the themes. One of these early themes stated “Technology supports teaching and learning” while the other one said “Technology can be used to engage students and increase their learning.” My dissertation chair questioned how these two themes were different, which prompted me to examine all of the codes organized under these two themes again. During this re-examination of the themes, I arranged the codes in each category according to the participant’s level of technology integration (see Figure 4.8). This proved helpful because it allowed me to see that participants’ levels of integration were related to their beliefs about the role of technology in the classroom, which became theme 1.

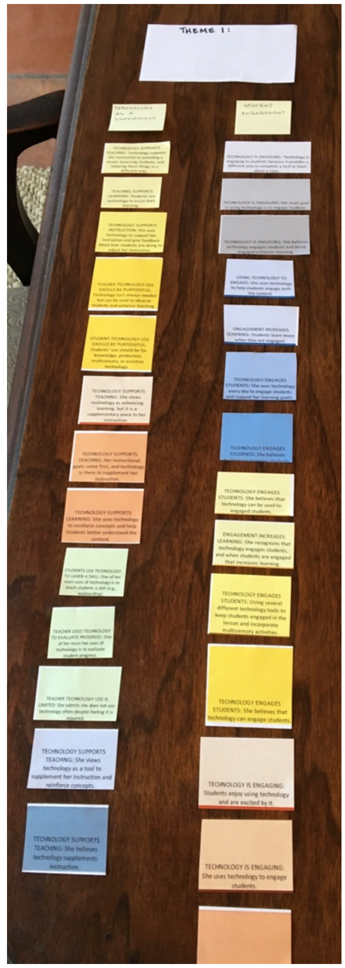

Figure 4.8. Codes arranged by participants' levels of technology integration.

I went back to the codes arranged on the table and continued sorting and organizing. In our second meeting, we reviewed the themes and revised the wording on a few. Figure 4.9 shows the final arrangement of codes, categories, and themes.

Figure 4.9. Codes organized by theme.

In conclusion, qualitative analysis of the data resulted in six themes and 12 categories. To verify the accuracy of these themes, I conducted member checking. Member-checking gives participants an opportunity to review the findings and state whether they accurately depict their experiences and perspectives (Merriam & Tisdell, 2016). I emailed each participant individually and included a list of the themes along with a short description of each. I asked participants to review the themes and respond stating if they felt the themes reflected their experiences or suggest changes if they did not. All six participants responded to my email expressing agreement with the themes; none of the participants offered suggestions for changes. Qualitative findings are presented below using rich, thick descriptions from participants (Creswell, 2014).

Presentation of Findings

Six themes were generated from the qualitative interviews and classroom observations. Table 4.20 presents each theme along with the categories, example pattern codes, and first-cycle codes associated with it. For example, first-cycle coding generated the codes *Engaging with Content*, *Creating Digital Models*, and *Playing Smartboard Games*. These codes were combined to create the pattern code *Using Technology to Engage*, describing how teachers were using technology to engage students. This pattern code joined another pattern code, *Engagement Increases Learning*, to form the category Technology to Engage Students. This category describes teachers' beliefs that the role of technology was to engage students. Then during the second round of pattern coding, this category was synthesized into the theme "Teachers' beliefs about the role of technology are influenced by their level of technology integration." The following paragraphs describe the themes and categories in more detail. All participants' names that appear are pseudonyms. Quotes from interviews with participants are used to provides examples and support the descriptions of themes and categories. All quotes from participants are verbatim and appear in quotation marks.

Table 4.20 *Themes that Emerged from Qualitative Data*

Themes	**Categories**	**Pattern Codes**	**First-Cycle Codes**
Teachers' beliefs about the role of technology are influenced by their level of technology integration.	Technology as a supplement	Technology supports teaching Technology supports learning	Supporting Instruction with Technology, Assisting the Teacher, "technology is useful to put on top"
	Technology to engage students	Engagement increases learning Technology engages students	Playing Smartboard games, Technology Enhances Learning, "a good tool to engage kids"
Teachers believe technology use should be balanced with	Teachers' perceptions of multisensory methods	Hands-on methods are important Multisensory component	Incorporating Multisensory Activities, "integrate the sensory motor aspect [with writing]"

Themes	Categories	Pattern Codes	First-Cycle Codes
multisensory methods.	Balancing technology and multisensory methods	Using technology for multisensory component Balancing technology and hands-on methods	Finding Balance in Technology Use, “technology versus other hands on methods,” Technology Provides a New Avenue to Learn About a Topic
Teachers are motivated to use tools that are easy for them and their students.	Ease of use	Ease of use Motivated by ease of use	Selecting Technology That’s Easy to Use, “easiest for me to grade,”
Teachers’ beliefs are dynamic.	Recognizing the benefits of technology	Shifting attitude toward technology Personal productivity	Connection with Distance Learner, “faster that typing a sheet”
	Concern of overreliance on technology	Worried about technology overuse Reducing technology use	“these kids have been on the screen too much,” Balancing Technology Use
Distance learning influenced teachers’ perceptions of technological knowledge.	Importance of technological knowledge for technology integration	Robust teacher technology knowledge Teacher technology knowledge is required	Using Specific Technology for Specific Subjects, “teacher’s knowledge of technology is paramount”
	Expanding technological knowledge due to adapting to distance learning	Expanding teacher technology knowledge	Learning tools on her own, “push myself to learn something”
	Teachers' perceptions of student	Student technology knowledge	Preparing students with technological knowledge, Students

Themes	Categories	Pattern Codes	First-Cycle Codes
	technological knowledge	Independent student use of technology	Need Technological Knowledge, “practice independent work”
Teachers experienced more first-order barriers during distance learning.	First-order barriers • Time • Access • Co-teachers’ beliefs	Barrier: Time Barrier: Access Barrier: Other Teachers’ beliefs	Barrier – Time: “handing everybody the iPad” Barrier – Access: “destroyed my whole lesson”
	Second-order barriers • Technological knowledge • Teachers’ beliefs	Barrier: Lack of Teacher Technological knowledge Barrier: Teachers’ beliefs	Barrier – Technological Knowledge: “there’s a lot I don’t know how to do” Barrier – Teachers’ Beliefs: “it was a point of frustration for her”

Theme 1: Teachers' beliefs about the role of technology are influenced by their level of technology integration.

Teachers’ beliefs about the role of technology were gleaned from the three interviews with each participant. Upon analysis, it was apparent teachers held varying views about the role of technology in teaching and learning. The two experienced integrators viewed technology as an essential tool for their instruction because it engaged students, thus increasing their learning. However, two novice integrators and two intermediate integrators viewed technology as a tool to support, or supplement, their instruction. This discrepancy in how teachers view the role of technology has been recognized in the literature. Ertmer and Ottenbreit-Leftwich (2010) noted, “it is time to shift our mindsets away from the notion that technology provides a supplemental teaching tool and assume, as with other professions, that technology is essential to successful performance outcomes (i.e., student learning)" (p. 256). Furthermore, research suggests the nature of teachers' beliefs, that is constructivist or traditional, is a factor in technology integration (Hermans et al., 2008). This theme is comprised of the categories (a) technology as a supplement and (b) technology to engage students.

Technology as a supplement. This category was defined as teachers believing and using technology as an extra component to enhance their instruction. Novice and intermediate integrators expressed views that technology supported their instruction but was not an essential component of it. Some of the ways they used technology to supplement instruction were to provide a visual, evaluate students, and reinforce concepts. These uses align with teacher-centered, or traditional, methods of instruction. Researchers have found that teacher-centered beliefs negatively affected technology use in the classroom (Hermans et al., 2008). While novice and intermediate integrators did not state technology was essential for instruction, there were discrepancies between the two levels in how they viewed technology as a supplement.

Novice integrators. Olivia and Sophia, both novice integrators, held teacher-centered pedagogical beliefs. Olivia stated about her beliefs "I am definitely coming from teacher-centered, but I think the better way to go is of course student-centered." In addition, Olivia and Sophia displayed limited technology use during their initial observations and stated in interviews that they did not use technology frequently. Outside of the technology used to deliver their classes virtually, both teachers only used technology to present information during their first observations. Despite their limited use, both teachers expressed beliefs that technology use was expected, if not required. Sophia stated, "I feel like [technology]'s becoming less of an option....before you were like ‘oh, that’s a nice tool, but I’m still gonna do that this way and not use the technology.’” Similarly, Olivia noted, “In the last maybe five years or so it’s more required that students use technology in the classroom.” Their perception that technology use is required, however, has not motivated them to use it more.

When Sophia used technology, she viewed it as an addition to her instruction, but not an essential component in her lessons. For example, during her second observation, Sophia used virtual manipulatives in the iPad application Braining Camp to have students make numbers using counters and ten frames. When asked if this lesson represented her typical technology use, she expressed agreement, saying “I think that [the lesson] represents me using [technology] as an added experience, not so much a main avenue.” During this lesson, students also placed buttons on ten frames printed on cardstock to represent numbers. Sophia elaborated on her decision to use paper ten frames and the iPad app, saying “I did both because I think the multisensory part is really important for [students], so do that first and then use technology to supplement and enhance the lesson.” She had her students complete the same activity on cardstock and through the Braining Camp app, so the technology was supplementing her instruction. Furthermore, her purpose in using technology was to reinforce the concept students were learning by providing an additional manipulative.

Intermediate integrators. Emma’s and Charlotte’s stated pedagogical beliefs were not squarely teacher-centered. Emma described her beliefs as “in the middle” while Charlotte said her beliefs were teacher-centered but “moving towards student-centered.” They expressed views that technology was a supplement to their instruction. Charlotte noted,

> I think [technology] needs to be supportive and an area of communication. So if you're trying to communicate something visually, like [using an] Apple TV, [students] are able to see it, they're able to look and see what you're asking them to do.

Emma said about technology, "it's an aid to what I'm trying to teach or make them aware of." Charlotte used technology to inform her instruction by collecting information about students. She remarked, "I use [technology] because I want to get some sort of information that's gonna help me." This was evidenced in her first observation when she used Pear Deck for dictation with her students. She was able to see what they were writing in real time and provide feedback about their letter formation and spelling. Emma shared the view of technology to support instruction, stating "I think it's there to support the lesson that we're doing and to give another way for students to interact and show what they know and be creative and really just be a supplement to the content and the lesson." An added element to Emma's view of the role of technology was how it could support learning by allowing students to interact with the content.

Emma and Charlotte used technology to support their instruction during observations, but unlike the novice integrators, they recognized technology could support student learning and provided more learning opportunities for their students that involved technology. For example, Emma said, "[technology] just assists the teacher in letting them work with the content in other ways than just a teacher standing in the front of the room presenting material." One way she enacted this belief in her classroom was by having students play a learning game on the website Kahoot. Charlotte's focus on technology to support student learning centered around assistive technology. She noted, "technology can be useful for students with disabilities or needing support." As a first-grade teacher, she used audiobook resources, such as Epic, to allow students to enjoy literature that they were unable to read on their own. She noted,

> Because of technology, different types of books are accessible to [students] that are read to them that they might not have picked up and been able to understand or to read or comprehend because they weren't able to read them.

Charlotte recognized that technology could assist student learning by allowing students to access content that they would not be to access independently.

Technology to engage students. This category is defined as teachers using technology to engage students and interact with the content. DiPietro (2010) identified engaging students with content as an essential way for online teachers to cultivate knowledge. Two intermediate integrators and two experienced integrators expressed beliefs during interviews about technology engaging students. Teachers used technology to engage students by making learning relevant to their lives and giving them multiple opportunities to interact with the content. These uses align with student-centered instruction (An & Reigeluth, 2011; Hermans et al., 2008). The experienced integrators also viewed technology as an integral part of their practice.

Intermediate integrators. Charlotte and Emma used technology to engage students, but they expressed different reasons for doing so. Emma stated she uses technology "to pique their interest and keep [students] excited." She saw technology as an opportunity to engage students by making them interested in the content and sustaining their attention. This was witnessed during her first observation when she had students shift between synchronous direct instruction and self-paced independent practice in Seesaw and Kahoot. Charlotte associated student engagement with increased student learning. She said, “we want to keep them engaged and do what we can to engage students and improve their learning.” For her, students learned more when they were engaged in the lesson, and she viewed technology as a means to provide engagement. Charlotte also used technology to engage students by making the content relevant to their lives. She stated, “students become more engaged when you teach them based on what they like or what they enjoy learning and based on their interest, and I think technology can help with that interest.” She recognized that harnessing students’ interests through technology could keep them engaged.

Experienced integrators. Like the intermediate integrators, experienced integrators used technology to create excitement and interest for students. For Amelia, the novelty of technology was a significant factor in using it. She noted using technology “gives [students] one more opportunity to do something that is not what they’re used to and it wakes up their brain.” Rachel expressed a belief that student engagement was central to student learning. She noted, “if you can make them more engaged, then their learning is gonna grow exponentially.”

Experienced integrators used several different methods to engage students through technology. Rachel believed that making content relevant to students increased their engagement. She noted, “if they’re more engaged and they’re taking charge of their learning, then it’s going to be a lot more relevant for them and they’re going to be more excited about it.” During the first observation, Rachel tapped into students’ interests for her math lesson on adding decimals. She showed students the Target website and told them they could each pretend to buy a game. She scrolled through the different games available on the website and students picked one they liked. Rachel then recorded the price of each game the students selected into an addition problem for the class to solve. Rachel made the math problem relevant to students by giving them choice in selecting a game and providing a real-world context where they would be adding decimals.

Experienced integrators also provided multiple ways for students to engage with the content. DiPietro (2010) found teachers in her study offered multiple opportunities for students to engage by making content accessible and integrating technology. Amelia exhibited this same spirit giving students multiple opportunities to learn about a topic. She said about students using technology to create something, it gives them "one more opportunity and one more layer to learn about a topic or an idea past just writing about it or solving that math problem or reading that word." Her beliefs were enacted in her practice during her first observation. During this lesson, her students worked on a multi-day project creating their own store. She used Classkick to share materials with students, such as graphic organizers, where they planned what they would sell, the price of each item, and a slogan for their store. Amelia used technology to give students opportunities to practice writing, spelling, and math in order to create a product.

One way Rachel helped students engage with the content was to make it accessible for distance learning, especially in the face of the rapid change in course delivery formats. She wanted to make sure students always had the resources they needed, and she saw that technology could provide that accessibility. Rachel stated, "they always know that they can go grab an iPad, pull out the virtual manipulatives and be able to represent their thinking if they get stuck or need help or they just want to show [their work] in a different way." Rachel also integrated technology to help students engage with the content. During distance learning, technology became a more important tool to engage students due to the constraints of teaching online. She noted,

> With digital learning, technology has really come in for that student engagement piece because the more that they're engaged, whether it's a Connect Four game on Jamboard, solving a math problem, or a Seesaw activity where they're going on a scavenger hunt around their house, they're just more engaged and then you get a lot more accomplished and more skills learned in that time.

Rachel recognized the need to keep students engaged during distance learning when students were suddenly learning from the comfort of their own homes. By using different technology tools in her lessons, she was able to maintain student engagement.

One difference between the experienced and intermediate integrators was the belief by experienced integrators that technology was essential to their practice. As suggested in the literature, teachers' beliefs play a significant determinant in the adoption of classroom technology (Hermans et al., 2008). Amelia and Rachel held the most student-centered beliefs of all participants. Rachel described her pedagogical beliefs as "leaning student-centered" while Amelia stated hers were "more student-centered" but admitted she shared "an aspect of both."

For Rachel, engaging students with technology was tied directly to her learning goals. She was unable to separate whether her technology use related more to her learning goals or student engagement. She stated, "It's both because some of our apps like Braining Camp, it engages them, but it's also tied directly to our learning goals. So I think they go hand in hand." The interrelated quality of technology, engagement, and learning goals made technology an essential part of her instruction. When asked how technology helps her as a teacher, she said, "it's an integral part of our day, of every day." She elaborated, "it just applies to any different setting, small group, one-on-one, whole class; we can use it in any content area across the board." Rachel viewed technology not only as essential but also appropriate for any setting or content area.

Amelia also viewed technology as essential to her practice, but she expressed the important role it plays differently. For her, technology was a vital part of her lesson planning process. She articulated, "I use Google Slides and have my [math] lesson mapped out throughout the slides." She elaborated further on the importance of technology, "If I didn't have a computer and all of [this hardware and software], I would have to completely change how I do planning and communicating and collaborating." Technology was essential to Amelia because it allowed her to create lessons in an efficient way. She used presentation software to create instructional material and guided practice problems for her lessons that she could follow while teaching.

Summary. Teachers exhibited different mindsets about the role of technology for teaching and learning. Experienced integrators adopted a mindset that technology is essential to instruction. They used technology to allow students to engage with the content and make learning relevant for them. Conversely, novice integrators viewed technology as a supplement, and incorporated technology into their practice to provide visuals and reinforce concepts. Interestingly, intermediate integrators straddled both categories, recognizing that technology can be used to engage but also viewing it as a tool to support their instruction.

Theme 2: Teachers believe technology use should be balanced with multisensory methods.

A core principle of the Orton-Gillingham Approach is the use of multisensory instructional methods (Orton-Gillingham Academy, 2018). All teachers in the study emphasized the importance of multisensory instruction for students with dyslexia. This theme encompasses teachers' belief that any technology use integrated in the classroom must not replace multisensory instruction but be used in conjunction with it. This theme consists of the categories (a) teachers' perceptions of multisensory methods and (b) balancing technology and multisensory methods.

Teachers' perceptions of multisensory methods. Multisensory methods are defined as instructional methods that require students to use multiple modalities, such as seeing, hearing, and feeling. Some teachers also referred to multisensory methods as hands-on methods. An example of a frequently used multisensory method of instruction is dictating words to students to practice spelling. The teacher will say the word, students will repeat the word, and then students will write the word. In doing this activity, students use auditory, visual, and kinesthetic pathways, thus making it multisensory. Teachers at the school are trained to incorporate multisensory methods in all subject areas. Teachers stressed the importance of multisensory methods, but they showed variation in their perceptions of how technology could be use with multisensory methods.

The importance of multisensory methods was a unanimous sentiment expressed by teachers. Pattern codes representing multisensory methods were generated from all participants either through interviews or during classroom observations where these methods were observed. Olivia noted, “I always try to put a lot of multisensory aspects into my lessons, meaning hearing, seeing, spelling, so that drives my lesson plan.” Making multisensory methods a focal point of her lesson planning process revealed the importance and value Olivia placed on these instructional methods. She elaborated on this process, “they need to have a strong visual, after they have the strong visual, they need to hear it, but they also need to be doing something as a motor component where they write.” These elements of her lesson were observed in her classroom practice when she provided a visual to students by using a Smart Notebook presentation and dictated words to students, which they repeated and wrote in their spirals.

One teacher recognized that she could use technology to provide a multisensory component. For Emma, an intermediate integrator, an iPad afforded an opportunity to incorporate learning activities that used sight, sound, and touch. For example, she noted, “[technology] is just another way to tap into all of the different learning modalities that we use.” This was evidenced in her classroom observation when she had students write words in Seesaw and record themselves reading the words. She also used virtual manipulatives to provide multisensory activities. She shared, “when we’re talking about phonics or math, we can teach the content and then they can actually try to apply it by different manipulatives or tools that they’re using in whatever app or software that we’re offering to them.” She viewed technology as a tool that provided additional ways to manipulate content.

For experienced integrators, the use of multisensory methods or technology depended on the content. Amelia stated about her use of technology “in Phonics, not so much because, I mean pencil to paper, but with math I use Pear Deck to give that student one-on-one time where it's not presented to the whole class." Rachel also expressed the idea that multisensory methods were dependent on the situation when she said, "we are trying to go to a lot more technology instead of paper and pencil, but there's still the place for paper and pencil." These teachers recognized the importance of multisensory instruction but also saw benefits to using technology for instruction, and they used their technology knowledge and content knowledge to make instructional decisions.

Balancing technology and multisensory methods. Given the belief that multisensory methods are essential for instructing students with dyslexia, teachers expressed a desire to balance technology use with these methods. For example, Emma noted she was "trying to keep a gentle balance, an appropriate balance of technology versus other hands-on methods that can be used." Interviews revealed teachers held varying beliefs about how to combine technology with multisensory methods. For example, Amelia used an incremental approach and slowly introduced more technology during the week. For Olivia, the distance learning experience changed how she created learning activities.

Amelia had a unique approach to combining technology and multisensory methods in her lessons. She thought about balancing technology with multisensory methods during each lesson as well as throughout the week. She stated about learning activities in her lessons, "I try to do a sandwich of pen paper, bulk of technologies, mostly Pear Deck, and then a game or an activity that's hands-on." She built her lessons by using multiple learning activities, and students shifted from pencil and paper activities to technology-based activities. This was witnessed during her second observation of a math lesson. Early in the lesson, students solved math problems using pencil and paper.

Then, they used virtual manipulatives in the Braining Camp app to create t-tables and solve problems. After that, students completed an exit ticket in Classkick before starting a math game the teacher had created that was printed on cardstock. In addition to each lesson, Amelia thought about slowly increasing how much technology students used throughout the week. She stated, "we begin the week with pen to paper work and hands-on activities, but then as we continue on throughout the week, I'll incorporate more technology." She was strategic in deciding when to use technology and how much to use.

Olivia demonstrated a significant change in how she combined technology with multisensory methods over the course of this study. Initially, she stated, "I use [technology] on a very limited basis." She viewed technology as "an independent tool for kids to learn a tech, to learn a skill." Therefore, her lessons did not incorporate much technology use by students, and her own use often revolved around using technology to provide a visual for students. However, the distance learning experience forced her to use technology in ways she had not before. After returning to in-person learning, she began to rethink her lessons and how she could incorporate more technology. During her second observation, she had students complete a daily oral language activity in Seesaw. The students went through sentences one at a time correcting them while she displayed her iPad on the Smartboard and made corrections. In her third interview, Olivia reflected on the lesson:

> My biggest struggle really is, especially with this age group, that I often think more in terms of finding that multisensory component in my lesson, and, therefore, I so often tend to go more paper pencil than technology. But with this lesson I found a happy medium between both, and I realized as I was doing it that

> observing the students fixing their mistake was actually easier by using Seesaw because I could quickly see everybody from the back.

Olivia found that she could strike a balance between using technology and incorporating multisensory methods in her instruction. In addition, she realized technology could make some activities easier for her.

Summary. The in-house training provided to teachers as well as the school culture emphasized using multisensory methods of instruction to teach students with dyslexia. Therefore, teachers expressed strong agreement that these methods must be present in their lessons. When considering technology use, teachers were strategic so as not to lose the multisensory component, and this frequently resulted in striking a balance between technology and multisensory methods.

Theme 3: Teachers are motivated to use tools that are easy for them and their students.

Davis (1989) identified perceived ease of use as one of two factors that drive technology integration. He defined it as "the degree to which a person believes that using a particular system would be free of effort" (Davis, 1989, p. 320). Previous research has found teachers' decisions to use technology in their classrooms are influenced by the perceived ease of use of that technology (Joo et al., 2018; Vareberg & Platt, 2018). Similarly, all of the teachers in this study cited ease of use, either on their part or the students' part, as a factor in deciding to use technology. For five teachers, *Ease of Use* emerged as a pattern code during the second cycle coding process. Teachers sought and chose technology tools based on how easy they were for them to use. When asked to what extent she considered how easy a tool was for her, Rachel said,

> I think that's a pretty big factor because there's just so many options out there like Seesaw and Pear Deck and Google Slides and Google Drive and all of that, and sometimes I pick one over the other just because it's a little bit easier.

For Amelia, efficiency in creating files along with grading student work and returning it to them were factors. She stated, "I would mostly say I pick Pear Deck and then Classkick [because] those are the two easiest for me to make and grade and to send back corrections." These tools required minimal effort for the teacher to create assignments for students, distribute them, and provide feedback, making them appealing choices for her to use.

In addition to their own ease of use, teachers considered how easy tools were for their students to use. Amelia stated, "I try to use technology that requires very little steps and then kind of look at it from a student perspective and see if it's something that's doable for a fourth grader." For her, student ease of use equated to the number of steps they would have to complete and how appropriate the technology was for their age and stage of development. Selecting tools by viewing how students would experience them was a priority for her. Emma also considered students' ease of use and noted, "If it's too hard and we're spending a lot of time teaching them how to use an app as opposed to we're using this app to support our content that we're trying to teach, then I'm not going to use it." How easy the tool was for students to use was a significant factor in her decision to use it because she did not want instructional time spent teaching how to use the tool.

Teachers also related students' ease of use with tools that were familiar to students. For example, when asked why she chose to use Seesaw for the lesson I observed, Olivia stated, "because the kids know it already. They were already familiar with it."

Summary. All six teachers expressed value in how easy technology tools were to use. Their decisions to select tools were often driven by considering how easy the tool would be for them and their students. The time involved in teaching students how to use tools was a significant consideration. For example, Olivia said Read Naturally Live was her most frequently used technology tool because "It's easy to administer. They all know how to do it. There's not really any time lost on additional instruction." Teachers valued ease of use because tools that were free of effort allowed teachers to focus on instruction and students to focus on learning.

Theme 4: Teachers' beliefs are dynamic.

Teachers' beliefs toward technology changed over the course of this study. Three teachers recognized new uses for technology within their classrooms while two teachers grew concerned over how much technology was being used. A previous longitudinal study found that teacher's beliefs are not linear and changed over time, which in turn affected their practices (Levin & Wadmany, 2006, 2008). The technology-rich distance learning environment was a catalyst driving this change. This theme consists of the categories (a) recognizing the benefits of technology and (b) concern of overreliance on technology.

Recognizing the benefits of technology. This category describes a change in teachers' beliefs toward identifying beneficial uses for technology over the course of this study. The transition to distance learning forced teachers to change their instruction because they were no longer in physical proximity to their students. For three teachers, this change highlighted the significant role of technology in instruction. Two teachers also discovered technology could increase their personal productivity.

Teachers recognized technology played an essential role in distance learning. When asked in her initial interview about the role of technology in the classroom, Sophia stated, “I would say it’d be supplementary.” However, in her second interview, she responded to the same question saying, “It’s crucial. I think it can make or break a lesson or make and break a school year.” Sophia realized that without technology, she would not be able to continue teaching her students for the remainder of the school year. The role of technology in her classroom changed from being a supplementary tool to one that was essential for instruction. Olivia also experienced a change in her beliefs about the role of technology. She reflected on this change in her second interview noting, “Before this distance learning, my attitude was technology is useful and great to put on top of everything else we do.” She continued, “I mean, distance learning without technology is just not gonna happen.” Olivia and Sophia were both novice integrators who viewed technology as a supplement to their instruction, but distance learning forced them to rethink the role of technology.

Through the distance learning experience, teachers also realized technology could be used in ways they had not used it before. For example, Olivia wanted to hear her students read frequently in order to monitor their decoding, fluency, and comprehension progress. During in-person learning, she could call students to her desk and have them read a comprehension passage aloud. However, during distance learning, she began using

Seesaw to assign reading comprehension activities to students and had students record themselves reading. She remarked on this,

> What was so valuable is that [there] was a lot of reading going on that I could then listen to, so I felt that I was really kind of in close contact with the students because I heard what they read, how they read it, and how they did with the assignment.

Olivia found a new use for Seesaw that allowed her to hear each student read every day, which was not possible in person due to time constraints. This activity gave her a sense of connection with each student and an understanding of their reading skills.

Emma, an intermediate integrator, also found ways to use technology to replace her classroom activities in the distance learning setting. One activity teachers commonly used to help students learn to spell difficult words was called technique. In this activity, students traced a word three times while saying each letter aloud; then, they wrote the word three times from memory. Emma found she was still able to have students do technique during class by using Seesaw. She stated, "I'll send them off to Seesaw, and they'll do technique on Seesaw as opposed to in their book." By utilizing Seesaw, she was able to see that the students traced the word three times and could hear them saying each letter aloud before writing the word. Another tool Emma used technology to replace was her whiteboard. During her first observation, she shared a Smart Notebook presentation with her students and used the pen features to write on the board during class. When asked about why she selected this tool, Emma remarked, "that day I was introducing [bossy R] with magic E, so I used Smart Notebook to be my whiteboard."

Emma realized using the Smart Notebook software and sharing her screen with students provided the same function as writing on her whiteboard in class.

Teachers also made statements about using technology in new ways for personal productivity. For instance, when asked what factors she considered when choosing a technology tool, Olivia responded, “I am really looking towards efficiency.” She recognized and appreciated the efficiency of Seesaw in creating activities. She stated enthusiastically, “What is great about Seesaw is that edit and copy feature. Within minutes you have a new activity. It’s faster than typing a sheet.” Olivia found these features in Seesaw a quick and effortless way to create new activities for her students based on ones she had created previously, thus, increasing her personal productivity.

Two teachers began using technology for lesson planning. Emma expressed enthusiasm regarding efficiency when using an online lesson plan book. During our third interview, she shared that she was using technology to streamline the distribution of work to students and using less paper. She added, “I’m even using an online plan book this year that I didn’t use before because I just find it easier....instead of having to write my lessons down or make copies for [my co-teacher when I’m out] I [can] just share it with her virtually.” Her lessons being online allowed her to easily make changes, insert hyperlinks to presentations and websites, and share her lessons with others. Sophia also used technology for lesson planning and found benefits to this method. She shared, “I used Google Docs to do all my lesson plans with [my co-teacher].” She further elaborated, “we virtually collaborated like ‘okay, what are you doing in math today?’ and ‘this is what I’m doing in math.’” By using a shared word processing document, Sophia and her co-teacher were able to see what the other one was planning and collaborate with one another on the day's lesson.

Concern of overreliance on technology. While some teachers found benefits to technology during distance learning, this change in beliefs was not unanimous. Two experienced integrators, who were enthusiastic about technology during their initial interviews, expressed growing concerns about technology use. Rachel mentioned, "I feel like the more technology that we're on, sometimes they are like zombies because they've been sitting, looking at a screen." She expressed concern over how much screen time students were getting at several points in her third interview and acknowledged her changing beliefs toward technology. When asked how the lesson I observed during her second observation aligned with her pedagogical beliefs, she stated, "I think that has kind of changed because I'm all about technology, but there have been some times where I'm like, okay, these kids have been on the screen too much and it's too much for them." This change in beliefs was evident in her observation. During the lesson, most of the instruction was teacher-centered and students were observed using technology only during the second half of class. She elaborated on the struggle she felt between wanting to use technology but being concerned about how much she was using:

> [I'm] just kind of finding the balance between too much technology and technology for the benefit of education. I'm kind of still trying to find that balance and finding some days we're just going to do paper and pencil, cause we're not going to get the iPad out today because we've been looking at a screen all day.

Rachel had initially expressed the belief that technology was appropriate for any setting and content, yet after the return to in-person learning she grew concerned about how much technology was being used in her classroom. Striking a balance between using technology and using other methods was important to her.

For Rachel and Amelia, the pressure of having to create everything in a digital format to prepare for a possible distance learner caused a change in their beliefs. Rachel mentioned that her lesson planning had begun to prioritize technology rather than her instructional goals. She stated, “We focus on how we’re going to deliver the content through technology.” She recognized this was a change from how she approached lesson planning the previous year and noted, “I think last year we focused on what we’re going to teach and how we’re going to teach it, and then we added that technology in as we could. This year I feel like it’s kind of the opposite.” Amelia also made statements about how prioritizing technology affected her classroom and her beliefs. She remarked,

> Before distance learning, incorporating technology was something exciting for me. I really enjoy adding it in because it didn’t need to be added in. So being able to incorporate these new things was so awesome and cool for the kids and they weren’t used to it and things like that. But now, because it’s needed every day, it kind of has lost its novelty for the kids, and for me a little bit.

Amelia had a distance learner in her classroom for the first few months of the school year. The challenge of creating digital materials daily for this student was taxing. She expressed her disillusionment with technology when she said, “I still like it and I still want to keep learning about it, but it’s not as innovative or exciting as it was before distance learning." Despite her lack of excitement for technology, she continued incorporating multiple technologies in her lesson during her second observation.

Summary. Teachers' beliefs evolved over the course of this study. Two novice integrators and one intermediate integrator recognized new uses for technology for their students and themselves. These teachers found technology could provide similar learning activities to ones they used in class. Two novice integrators also recognized technology could increase their personal productivity. For the experienced integrators, the increase in technology caused them to grow concerned about overreliance on technology in the classroom. While they valued technology as a tool to meet their instructional goals, the pressure of preparing everything in digital format in anticipation of a distance learner was stressful. For one teacher, the novelty and excitement of using technology was lost. For another teacher, providing students a break from screen time was important.

Theme 5: Distance learning influenced teachers' perceptions of technological knowledge.

In order to effectively integrate technology, teachers and students must possess technological knowledge. Koehler and Mishra (2009) identified technological knowledge as one of the three knowledge domains required for successful integration. All teachers in this study expressed beliefs about the importance of technological knowledge for integration. Teachers must know how to use technology tools as well as the affordances and constraints of the tools. Students must also know how to use the technology, and teachers placed value on students knowing how to use technology independently. The distance learning environment accentuated the need for technological knowledge for both teachers and students. This theme consists of the categories (a) importance of technological knowledge for technology integration, (b) expanding technological knowledge due to adapting to distance education, and (c) teachers' perceptions of student technological knowledge.

Importance of technological knowledge for technology integration. Technological knowledge refers to Koehler and Mishra's (2009) definition which encompasses more than just computer literacy to include understanding "information technology broadly enough to apply it productively at work and in their everyday lives, to recognize when information technology can assist or impede the achievement of a goal, and to continually adapt to changes in information technology" (p. 15). All teachers acknowledged that technological knowledge is required for effective integration, and for two teachers their lack of knowledge created a barrier to integration. This supports research findings that technological knowledge has a direct impact on integration (Taimalu & Luik, 2019).

Teachers recognized that it was essential to have technological knowledge. Olivia acknowledged, "The teacher's knowledge of the technology is really paramount." Emma stated simply, "The teacher has to be comfortable with the technology that they're using for it to be effective." These statements express the importance of knowing how to use technology tools, and the online learning environment required it even more so. Olivia remarked, "I feel that I do not really have enough tools in my toolbox to be effectively teaching online." Teachers understood that technological knowledge encompassed more than knowing how to use the tools but understanding how technology could interact with their content and pedagogy. Olivia added, "once I would know more, I would also know how to instruct better." The distance learning environment highlighted Olivia's lack of technology knowledge. When reflecting on her first lesson I observed, she shared:

> [My co-teacher and I] lack so much knowledge that we don't use this technology the way we should be using it. [We were] thinking that when you are in this kind of setting you should not try to resemble what you did in the classroom. So what we did was pretty much the best we could with the knowledge we have, and we felt kind of medieval age.

She understood that her instructional methods needed to change for the online environment, but she did not have the technological knowledge to make those changes.

Expanding technological knowledge due to adapting to distance education. Teachers' technological knowledge increased during distance learning. They had to quickly shift from in-person learning to synchronous online learning. Teachers identified limitations of teaching online and sought ways to overcome these limitations through technology. They explored tools on their own and expanded their technological knowledge to meet students' needs. For one teacher, her co-teacher's extensive technological knowledge helped expand her own technological knowledge.

Four teachers credited the distance learning experience for expanding their technological knowledge. Sophia stated, "I had to think of a way to do my math lesson all online. Not that I wouldn't necessarily do it the way I did, but it pushed me to have to go explore more on Braining Camp." For her, distance learning motivated her to explore new capabilities of tools. Amelia expressed a similar sentiment: "I knew I needed to find something, one extra thing, and so I would say with distance learning it's made me explore more things and kind of push myself to learn something without always knowing you're an expert on it." Given the quick transition to distance learning, Amelia realized she did not have time to learn new tools to the depth she was accustomed, but she explored new tools in order to meet her students' needs. The distance learning experience created new needs for teachers, and Charlotte used technology to fill those needs. For example, Charlotte quickly learned that not being able to see what her students were writing presented a challenge. She stated,

> I dove into figuring things out for sure, like Explain Everything. I wanted to know I could use it and how it could be helpful for those students and being able to see in real time how they're doing, what they're doing.

While the distance learning experience thrust teachers into an unfamiliar environment, it also built confidence in their technological knowledge. Emma remarked, "I feel like if it's something that I don't know, I'm much more apt to learn it or put myself out there and try to figure it out where before I might've felt like 'Oh, I'm not sure that I can do that.'"

Teachers within teaching teams often did not have the same level of technological knowledge. Olivia, a novice integrator, benefitted from her co-teacher's extensive technological knowledge, which helped expand her use of technology during distance learning. For example, she said, "Working with [my co-teacher] and her having more technological knowledge, she helped me along with certain things." They also supported each other during synchronous instruction throughout distance learning. Olivia noted, "It felt very comfortable having both of us [in the virtual classroom] as a kind of safety net."

Olivia explained that while one taught, the other one provided classroom management and technical support if needed. In her third interview, she reiterated praise for her co-teacher saying, “Working with [my co-teacher] was a blessing because she knows more....she was my greatest support.” I witnessed this supportive relationship firsthand during Olivia’s second observation where she had students complete a Seesaw activity together in class. As they started working, she realized the text boxes within the activity were moving around on the students’ screens when they tried to write. Her co-teacher quickly stepped in and walked Olivia through how to lock the text boxes, which she then relayed to the class. Olivia’s co-teacher was able to provide technological support and share her knowledge, which in turn helped Olivia feel comfortable using more technology.

Teachers’ perceptions of student technological knowledge. This category describes teachers’ beliefs that students need technological knowledge for integration to be successful. The literature on TPACK and technological knowledge does not describe the knowledge and skills students need for effective technology integration; however, all six teachers spoke about student technological knowledge in their interviews. Despite agreement on the need for students to possess technological knowledge, teachers varied in why they felt students needed this knowledge. Some teachers expressed feelings of responsibility to teach students to use technology, while other teachers valued students being able to use tools without depending on a teacher.

Two teachers felt it was important for students to have knowledge of basic computer skills in order to complete classwork and be prepared for future learning environments. Rachel believed students need explicit instruction in how to use technology. She stated, "all kids need direct, explicit instruction, so that really good direct, explicit instruction in the beginning, how to use [technology], how to navigate it." She elaborated, "they just need to learn basic skills like knowing what the buttons [do], like the closing out and the minimizing and expanding, logging in and out, being able to recognize the different icons and what they mean." Rachel took the initiative to teach her students these skills. For example, prior to transitioning to distance learning, she introduced her students to Google Meet by having them practice presenting a book report to her from a different room in the school. This gave her an opportunity to show students how to join a meeting and introduce some of the tools, such as how to mute or share their screens.

Amelia also felt that students needed technological knowledge, but she expressed a strong sense of responsibility in teaching students that knowledge. She stated, "I feel, especially with older kids, obligated as a teacher to make sure that they understand just how to log onto a computer, how to write on a Google document, and how to make comments." Amelia took action to teach students these basic skills, but her motivation extended beyond students needing to know these skills in order to participate in her classroom. She was concerned about students' technological knowledge compared to their same-aged peers. She noted when discussing students' ability to use Google Classroom, "it's definitely informed my teaching that [technology integration] needs to part of my instruction because otherwise they're going to fall behind." Her students' future readiness was also a driving force in teaching students how to use technology. Amelia admitted, "I want to make sure that the kids I'm teaching are prepared for life after [they leave this school] and they're prepared for not only school but other things in their lives that require a technology." She recognized the need to prepare students to be digital citizens due to the prevalence of technology in our society.

Four teachers expressed statements valuing students' independent use of technology. To Emma, students needed to know how to use the technology because it provided an opportunity for independent practice with concepts. For example, she shared during her first interview, "[Seesaw] is a good way for that independent piece where they get to do something and then I can respond to what they've done. So it provides that independent time [with technology for students]." Emma explained that she often structured her lessons to follow an "I do, we do, you do" format where she introduced concepts, guided students through practice work, and then gave students some type of independent practice. In order to complete their independent practice, students needed to know how to use the technology tools.

Olivia and Sophia saw growth in students using technology independently from a teacher. Olivia responded when asked what the role of technology was in students' learning, "it is a great tool for students to be more independent from a teacher." When asked how technology helped her as a teacher, she provided this example: "reading fluency, [students] can work independently without me listening, so there's some independence on the student's part." This was an opportunity for students to show they could complete work without assistance from a teacher. As a first-grade teacher, Sophia viewed students using technology independently as a benefit in her classroom. She stated, "some benefits in my classroom, I believe, are being able to give kids at such a young age more independence and more practice on their own because we are constantly one-on-one with them all day." When her students used technology independently, they were able to show her what they could do on their own.

Teachers associated students' independent use of technology with confidence. Charlotte noted, "technology is a way that students can feel confident in areas in the classroom." For Rachel, the prospect of quarantining at any time meant students needed to know how to use technology on their own at home. She stated, "we've been talking about any day it could happen and they could go home and we want them to feel confident and competent to be able to get on and join the class and do certain things." Teachers wanted students to be comfortable using the tools on their own and at times made decisions regarding technology use based on this. Charlotte said, "because I want my students to be able to independently use the technology, I'm not using as much to overwhelm them and just slowly implement and teach them different applications once they're comfortable with other applications." Amelia expressed a similar sentiment when she stated, "I didn't want to bombard them with a million different apps and things like that because I wanted them to feel confident using these things independently." These two teachers opted to introduce fewer technology tools to ensure students were confident in their ability to independently use the tools they had introduced.

Summary. Teachers were unanimous in the belief that teachers' and students' technological knowledge is required for effective integration. Teachers recognized that their own technological knowledge is complex and extends beyond simply knowing how to use the tools in their classrooms. Furthermore, the distance learning environment pushed teachers to expand their technological knowledge in order to meet their students' needs. Teachers also recognized the need for students to possess technological knowledge, although their reasons varied. For some teachers, students needed the know how to use technology independently in their classrooms. For other teachers, students needed technological knowledge to prepare them for their next school or their future careers.

Theme 6: Teachers experienced more first-order barriers during distance learning.

First- and second-order barriers have been cited in the literature as hindering technology integration (Hew & Brush, 2007). All teachers in this study experienced barriers to technology integration; however, they experienced more first-order, or external, barriers than second-order, internal barriers. The first-order barriers identified by teachers were time, access, and other teachers' beliefs. Second-order barriers identified by teachers included technological knowledge and their own beliefs about the role of technology in teaching and learning. This theme consists of the categories (a) first-order barriers and (b) second-order barriers.

First-order barriers. First-order barriers to technology integration are defined as those that are external to teachers but affect their teaching practices. Ertmer (1999) identified access to hardware and software, time to plan instruction, and technical support as some examples of first-order barriers. Teachers in this study cited first-order barriers more than second-order barrier as hindering their integration. Some researchers report similar findings (Francom, 2016; Wachira & Keengwe, 2010). The first-order barriers identified by teachers in this study are described in the following sections: (a) time, (b) access, and (c) other teachers' beliefs.

Time. All six teachers identified time as a barrier to integration. This sub-category refers to the time it takes teachers and students to learn technology as well as the time it takes to implement it. Francom (2016) found time was the most significant barrier to integration for teachers in a small school district. Time served as a barrier to integration in several ways. Teachers stated it takes time to learn new technology. Some teachers did not want to use instructional time teaching students how to use technology. Two teachers noted they ran out of time during class to implement technology. Finally, teachers felt distributing devices to students or logging into accounts used valuable class time.

Teachers must know how to use the technology tools they plan to implement, yet they acknowledged it takes time to learn new technology. Sophia explained, "I think that's probably the biggest issue for me with technology is the planning time, like having to go out and explore it myself and make mistakes and understand it myself." The time involved in learning new technology tools on her own prevented her from integrating it. Olivia also recognized that learning new technology tools requires time, but she found that extra time during distance learning. She stated, "because of distance learning, I felt that I had more time to look into Seesaw and find more ways of using it, playing with it." She followed with "I had the time to try things out and without it, I think it would have taken me even longer to figure out how to do certain things." For Olivia and Sophia, learning technology took time because they needed to explore the tool, experiment with it, and imagine how it could be used in their classrooms. Olivia found the modified schedule during distance learning gave her some time to do that, which in turn allowed her to integrate new technology.

Two teachers mentioned the time it takes to teach students how to use technology was a barrier. Charlotte, an intermediate integrator, cited this barrier in all her interviews. When asked if she could recall a time she was not able to use technology due to time, she responded, “I think taking the time to teach the technology, the application, or the app, it just takes extra time.” During our second interview, she provided a specific example of an instance where teaching students a new technology took time. She remarked, “without me being there hands-on was difficult and it took a little while for us to understand how to be in Google Meet or if they did have a question, they’d come to back Google Meet.” The transition to distance learning and using a technology tool that was new to her first-grade students took time to teach. It was particularly challenging for her students to learn how to move between multiple apps, such as Google Meet and Seesaw, within one class. Charlotte also mentioned that teaching her students often required more than one class period. She noted, “technology cannot just be rolled out in one [class] time because it takes time to use different productivity tools.” For Sophia, another first-grade teacher, the time to teach students was a hindrance as well as the time spent planning how to incorporate technology into her lessons. When asked if she could think of a time she was not able to use technology because of time, Sophia responded, “I think that’s the majority [of the time]. It’s the time in the classroom teaching the kids, but I also think it’s the planning time ahead [of the lesson].” Sophia found the time required of her outside of class and the instructional time required in class to teach technology were a barrier to integration.

For experienced integrators Amelia and Rachel, running out of time to implement technology in lessons served as a barrier. Amelia noted, “a lot of times with phonics, depending on where the students' understanding is, we probably will just cut out the Seesaw at the end if I don't feel like they're ready for this Seesaw." In her lessons, Amelia focused on student understanding before moving to technology, so she used class time to continue instruction if that was needed and eliminate the technology component. However, in these instances, she added, "I usually try to use it, technology that I plan to incorporate, either the next day or later that week because I've already planned it so I want to make sure I use it." While she may have run out of time to use technology in a particular lesson, she made an effort to include it somewhere else in her day or later in the week. Rachel expressed a similar sentiment:

> There had been a couple of times where if you're introducing a new skill or concept and you really just want kind of a little bit more teacher-directed [instruction] for that day for learning, and then the kids have questions and you move into some more exploratory learning where we've run out of time to incorporate more of that technology into the lesson.

For both teachers, they felt time served as a barrier to integration when their instruction took longer than they planned. However, they adjusted their lessons based on their students' needs and tried to incorporate technology at a later time when possible.

Teachers also mentioned the time it takes distributing devices to students and time spent logging into accounts to be a barrier. Olivia noted, "there's a little bit of administration time left to hand everybody the iPad and then return it to its place." She reiterated this point later in the interview: "Again, handing everybody the iPad, saying 'now let's go on Braining Camp, let's say now we are going to explore' and all that. It could be a time constraint." In addition to the time spent passing out devices to students, Olivia lamented the time it takes to log into accounts. She stated, "This morning I got really frustrated in math. I was planning to use Braining Camp [and display my iPad on the board using] Reflector, and it took [a student] a while to sign into Braining Camp with the app." The app required students to type a username and password which several students needed help with. She remarked about the time spent doing this:

> I felt like 'gosh, I did not think that this would take 15 minutes [to get logged in] because if I would be on the floor with Orton blocks, I would already have covered so much compared to signing into this.

For Olivia, the time spent signing into accounts was a challenging and time-consuming task for her third-grade students. This created a barrier to using the app because she knew she had other manipulatives she could give the students that did not require her to spend instructional time logging students in. Using instructional time for technology distribution or logging in was a deterrent for Sophia as well. She noted a few of the ways technology used time in her classroom, saying, "the time that it's going to take for the kids to either get [their devices] out, to get ready, for me to teach, or if it's going to be distracting."

Access. Successful technology integration requires having access to technology that is working properly when teachers and students need to use it. Wachira and Keengwe (2010) found unavailability and unreliability of technology was a major barrier to integration for teachers in their study. While the school provides plenty of technology to teachers and students, teachers identified access as a barrier to integration. Access became a barrier to integration when software was not available on devices or up to date and when technology was not working properly during a lesson.

Two teachers found access to be a barrier to technology integration because software was not available or up to date. Sophia took her students to view a fifth-grade exhibit created by students about the Lascaux Caves in France. Students needed to use the camera app on their iPads to scan QR codes, which then played audio recordings of facts about the caves. When Sophia's students opened their iPads, they were unable to find the camera app. She noted, "we brought all of our iPads there, but we didn't have a camera app [on our iPads]." Her students were unable to listen to the recorded facts because they did not have the software required to do so. Amelia encountered software that was not up to date, which prevented her from accessing technology. She stated, "there were times in the beginning of distance learning [when] my Smart Notebook wasn't updated." Not having up-to-date Smart Notebook software affected Amelia's integration because certain elements within her Notebook files did not appear, so she was unable to use those files for instruction.

Two teachers also found access to be a barrier when technology was not working properly. During her first interview, Amelia mentioned, "there was one day where the Smartboard just decided to not even turn on." Since all her lessons were created in Google Slides, this created a challenge. She elaborated, "We got through it, but it really kind of destroyed my whole lesson because a lot of it you have to be able to see what I'm talking about." Amelia relied on having access to working technology for her lesson, and when that failed it ruined her lesson. Rachel also experienced technology that was not working. She stated,

> In the beginning of the year when our Smartboard was kind of funky and sometimes working, sometimes not, that was a little bit tricky and a little bit of a barrier because we couldn't share [anything] through the board with everybody.

Rachel wanted to use her Smartboard to provide visual information to her students, but the unpredictability of the device created a barrier to use.

Co-teacher's beliefs. Co-teacher's beliefs are defined as the beliefs teachers hold about teaching and learning who are not the participants. Ertmer et al. (2012) found other teachers' beliefs to be the biggest obstacle to integration for teachers in their study. The school dynamic of having two teachers in every classroom influenced teachers and their technology integration. For two teachers, their co-teachers' beliefs served as a barrier to their integration.

Having two teachers in a classroom provides individualized instruction for students, but it also creates a complex working relationship between those teachers. They must navigate each other's experiences, values, and beliefs to make instructional decisions. This is especially true regarding technology use due to the emphasis on multisensory instruction as part of the school's approach to dyslexia remediation. Charlotte referenced this in her first interview: "you have to be cognizant of other people's beliefs about [technology] and what they want to use and they want students to be able to use, the type of technology and how to integrate that into the classroom." Rachel and her co-teacher shared similar beliefs about the role of technology in teaching and learning. For example, she said about her co-teacher, "We were kind of both on the same page about using technology all the time. We were both ready to explore things and try new things with tech." Because they shared similar beliefs and a willingness to experiment with technology, they were able to support each other's integration.

Amelia experienced barriers to technology use through other teachers' beliefs. As an experienced integrator, she is a technology leader in the school. During grade level meetings, she shared instructional activities with other teachers that they could in their classrooms. She relayed this to me: "There's times where I show a really cool Seesaw I did or a Pear Deck during our grade level meetings, and it's a little overwhelming [for some teachers] and they're not wanting to use it or see it through." Other teachers' unwillingness to hear about new tools or activities that Amelia had created and believed had instructional value was discouraging to her. However, these negative beliefs did not directly impact her ability to integrate technology into her classroom. Amelia's co-teacher's beliefs did create a barrier to her integration. She stated during distance learning, "[My co-teacher] wasn't negative because she's happy all the time, but [technology] was a point of frustration for her at times, so we just wouldn't use it." Her co-teacher's frustration with technology prevented her from using some tools that she would have otherwise used. This continued after we returned to in-person learning in the fall. When asked in her third interview about other teacher's beliefs being a barrier, she stated,

> It is the same answer as last time. I think it's a stress inducing and frustrating situation at times. If [other teachers] are not willing to hear suggestions or incorporate your ideas, it can be really difficult to continue on with the lesson with that. I have tended to let it go and say "Okay, we won't do that. We'll just do something else."

Amelia’s co-teacher's beliefs created a frustrating situation for her. The tension caused by their differing views about technology ultimately led Amelia to abandon using technology in some lessons.

Sophia also identified her co-teacher's beliefs as a barrier. When asked if her own beliefs served as a barrier, she responded:

> Not so much my beliefs, but I think my co-teacher's beliefs [are a barrier]. She has more of a traditional standpoint of pen and paper, which I think is great, but I also think it limits us in some other adventures we could have with technology, but I totally see her side too that the kids get [technology] all day.

Her response revealed an awareness of the contrast between her beliefs and her co-teacher’s beliefs. However, it also highlighted the complex relationship of working in the same room as another teacher for an entire school year. During our third interview, Sophia again identified her co-teacher's beliefs as a barrier, saying, “[my co-teacher] is not a big fan of technology a lot of the times, so there’s been certain things that I wanted to do or I wanted the class to do that is just too much for her.” As a young teacher working with a very experienced teacher, she felt the need to defer to her co-teacher when it came to making decisions about technology use in their classroom. The distance learning environment further complicated their co-teaching relationship. For example, Sophia felt internal pressure as the more experienced technology user within her teaching team. She stated, “I think because of my co-teacher I feel more pressure because I’m a little bit more adept at [technology]….I’m not just supporting my kids. I’m supporting her.” The transition to distance learning increased the pressure and responsibility Sophia felt to make sure her students and her co-teacher could use the technology required to learn remotely, but she also had to manage her co-teacher's expectations for how much technology use was too much.

Second-order barriers. Second-order barriers are defined as those that are internal to teachers, such as their beliefs about the role of technology in teaching and learning. Two novice integrators and one intermediate integrator experienced second-order barriers. Their lack of technological knowledge and their own beliefs prevented them from successfully integrating technology. Researchers have found lacking the knowledge and skills required to integrate technology can prevent teachers from using it (Hew & Brush, 2007; Wachira & Keengwe, 2010). Teachers' beliefs were also found to be a significant barrier to integration (Hermans et al., 2008; Inan & Lowther, 2010). This category consists of the sub-categories (a) technological knowledge and (b) teacher's beliefs.

Technological knowledge. Technological knowledge refers to the knowledge and skills required to use technology tools. It was identified by Hew and Brush (2007) as one of the main barriers faced by K-12 teachers. Technological knowledge served as a barrier to integration when teachers did not use tools because they did not know how to use them. Three teachers in this study found their lack of technological knowledge to be a barrier. For example, Emma explained why she did not use Pear Deck during distance learning saying, "I didn't really understand it, so I opted not to use it." Her lack of understanding a technology tool prevented her from using it.

Olivia admitted on several occasions that her knowledge and skills relating to technology were not robust. She understood that not knowing how to use technology tools herself prevented them being integrated into her classroom. She stated during her first interview: “The obstacle is really my knowledge, not so much the students’ knowledge.” Furthermore, she noted that in order to integrate technology more into her classroom she needed more technological knowledge. Distance learning required her to learn new technology tools to instruct her students and share learning activities with them. While she learned tools such as Google Meet and Seesaw, she continued to acknowledge a deficit in her technological knowledge. During our second interview, she said about lacking technological knowledge: “I really do have a handicap there. There is still a lot that I am unsure about and do not know how to do, and it’s, of course, frustrating not having that [knowledge].” Olivia found her lack of knowledge frustrating because she was aware that she could integrate technology more and use it successfully if she had more knowledge. She reiterated this point later in the interview saying, “there’s a lot I don’t know, and that’s intimidating.” I witnessed her frustration with technology during the second observation. She was using Reflector to display her iPad screen on the Smartboard, and Reflector quit when her iPad went to sleep while she was helping a student. When she went to use her iPad again and realized her screen was no longer being displayed on the Smartboard, she stated, “This is the part I do not like about technology. I don’t know why it’s not working.” Even after the distance learning experience and seeing an increase in her technology use, she offered the same response when asked what she needed to integrate technology more in her classroom by saying, “More knowledge on my part." She also continued to identify her technological knowledge as a barrier stating, "The greatest hindrance really is my own knowledge."

Sophia was another teacher who recognized her own technological knowledge as a barrier to integration. However, she felt her lack of knowledge was due to a lack of training. She stated in our first interview, "I don't feel like I have enough training sometimes even though I have that sense of 'I can figure this [technology] out.'" She identified training as what she needed to integrate technology more into her classroom. During distance learning, she attempted to learn new technology tools on her own. For example, she wanted to learn Jamboard so that she could share files with her students and see their work in real time. She said about this experience: "I watched a lot of videos myself on YouTube, and I did all this other stuff and really tried to play with it, but at the end of the day, I just didn't feel comfortable doing it." Ultimately, Sophia lacked confidence in her ability to use technology.

Teacher's beliefs. Teacher's beliefs are defined as the beliefs teacher's hold about teaching and learning, their beliefs about the value of technology for teaching and learning, and their confidence in their abilities to use technology for instruction. Teachers' beliefs are an essential factor in determining technology use by teachers (Inan & Lowther, 2010). Research has shown that traditional beliefs have a negative impact on technology integration (Hermans et al., 2008). Both novice integrators made statements revealing their beliefs served as a barrier to integration. Mostly, this was due to the value they placed on multisensory instruction. However, both teachers also lacked confidence in their technological abilities, which also created a barrier to integration.

Novice integrators held strong beliefs about incorporating multisensory elements into their lessons. Sophia expressed the belief that writing with a pencil was a superior multisensory method. She stated, “My understanding is that writing physically is the best, to have drag [from your pencil]. So chalk or a pencil, I think we rely heavily on pencil, but that helps that connection in the brain.” She believed students needed to feel the drag of a pencil or piece of chalk while writing in order to assist long-term memory of spelling. Sophia also believed multisensory methods were preferable to any other instructional methods. For example, Sophia stated, “I don’t think [technology will] ever replace one-on-one instruction because, especially with our model of the hands-on learning, that is what our population needs.” For her, technology, did not provide the same benefits to students with dyslexia as multisensory methods.

Similarly, Olivia placed significant value on incorporating multisensory methods into her lessons. She felt this was beneficial for developing fine motor skills, especially in younger students. For example, she said,

> If [students] have some fine motor issues, and they are still fairly young, they can be addressed with handling actual manipulatives that might be very beneficial for them to do rather than dragging and making [virtual manipulatives] automatically fit and jump [into place].

Olivia believed students gained more fine motor skills from handling real manipulatives than using virtual manipulatives. For her, the sensory component along with the trial and error of trying to make manipulatives fit together could not be recreated on an iPad. The importance both novice integrators placed on multisensory methods created a barrier to integration because they believed these methods were superior to using technology.

Olivia and Sophia also lacked confidence in their technology use, which created a barrier. For example, Olivia viewed using technology as taking a risk because she was unsure of how to handle problems if they arose. Her lack of technological knowledge impacted her self-efficacy. She relayed to me, “with technology, I often feel like [I’m] taking a risk....I really don’t like that risk taking. I always like to have a plan B.” Using technology was risky to her because she was not confident she could address technical problems. This led her to avoid using technology so she did not find herself in that situation. Sophia expressed her lack of confidence when she said, “[My co-teacher] and I don’t feel comfortable 100% teaching with technology all the time.” She explained that part of her discomfort related to a feeling of failure if she was not successful. She stated, “You feel like you got this and then if you add this other level, [teachers] feel like a failure at teaching if they can’t implement it, or I do when I can’t implement it.” Sophia was discouraged by unsuccessful attempts to integrate technology, and these experiences served to decrease her confidence in her abilities.

Sophia’s pedagogical beliefs also created a barrier to integration for her. She expressed the belief that students cannot learn as well online as they can in person. She mentioned in her third interview that some other teachers in her grade level were creating asynchronous lessons for their students by utilizing videos for instruction during distance learning. She stated about this, “I feel like I’m not giving them my best teacher me if I’m just giving them everything online.” Not only did she feel her ability to teach was lessened by creating videos, but she also felt this limited student learning. Sophia stated, “There’s just so much to learn from doing in-person [instruction] that I feel like I wouldn’t be giving them the best me by doing that, so I wouldn’t ever want to take away from their learning.” For her, in-person, synchronous learning provided a better learning experience for her students than asynchronous video instruction.

Summary. This theme identified the barriers teachers faced when integrating technology. All six participants in this study experienced first-order barriers. The most frequently cited external barrier was time. Teachers found the time required to learn new technology and teach it to their students prevented them from using it. Some teachers also found the time spent distributing devices and logging into accounts was a deterrent to use. Access served as a barrier for teachers when software was not available or not updated. Teacher interviews revealed other teachers’ beliefs affected technology integration with some teachers hindered and others supported by their co-teachers. Three teachers experienced second-order barriers. Technological knowledge was cited as a barrier to integration. They stated not knowing how to use technology tools prevented their use in the classroom. Two teachers also struggled with technology integration because of their beliefs about teaching and learning. Valuing multisensory methods over technology use, lacking confidence in their ability to use technology, and questioning the impact of online instruction on learning were the main beliefs that served as barriers.

Chapter Summary

This mixed-methods study utilized quantitative and qualitative data to identify teachers’ beliefs about technology integration at a school for students with dyslexia. Quantitative analysis collected via a survey provided an overall understanding of technology integration at the school and identified six teachers who represented three varying levels of integration: (a) experienced, (b) intermediate, and (c) novice. Qualitative data was collected from the six participants through interviews and classroom observations. Data analysis revealed six themes: (a) teachers' beliefs about the role of technology are influenced by their level of technology integration, (b) teachers believe technology use should be balanced with multisensory methods (c) teachers are motivated to use tools that are easy for them and their students, (d) teachers' beliefs are dynamic, (e) distance learning influenced teachers' perceptions of technological knowledge, and (f) teachers experienced more first-order barriers during distance learning. Quantitative and qualitative findings were integrated to provide a complete understanding of teachers' beliefs, practices, and barriers related to technology integration. Findings from this study and their implications are discussed in the following section.

CHAPTER 5

DISCUSSION, IMPLICATIONS, AND LIMITATIONS

The purpose of this action research was to describe teachers' beliefs and practices relating to technology integration at a school for students with dyslexia. Quantitative data were collected through a survey sent to all faculty members at the school. Teachers who completed the survey were sorted by their level of technology integration, and six teachers representing three different levels of integration were invited to participate in qualitative interviews and observations. Survey responses, interviews, and classroom observations were analyzed to answer the following research questions: (1) What are new online teachers' beliefs about the role of technology in teaching and learning at a school for students with dyslexia? (2) What are new online teachers' perceived barriers to technology integration at a school for students with dyslexia? and (3) How do new online teachers' observed classroom practices align with their stated beliefs about technology? This chapter converges the findings of this research with the previous research through the following sections: (a) discussion, (b) implications, and (c) limitations.

Discussion

To answer the research questions, quantitative and qualitative research findings were integrated. Interpretations were situated within the larger context of research on technology integration. As such, understanding teachers' beliefs about the role of technology in teaching and learning was necessary. It was also important to understand what barriers teachers perceived to exist which prevented them from integrating technology into their classrooms. The TPACK model served as a framework for understanding the knowledge and skills needed for effective technology integration. The discussion of findings is organized by the three research questions of the study.

Research Question 1: What are new online teachers' beliefs about the role of technology in teaching and learning at a school for students with dyslexia?

In this study, teachers' beliefs about the role of technology encompassed pedagogical, self-efficacy, and value beliefs teachers held about the use of technology for teaching and learning. Research suggests teachers' beliefs play a significant role in whether they decide to integrate technology (Hermans et al., 2008; Inan & Lowther, 2010; Taimalu & Luik, 2019; Tondeur et al., 2017). Quantitative and qualitative data in this study provided a more complete understanding of teachers' beliefs about the role of technology. This section describes findings that answer the first research question with reference to the previous research on teachers' beliefs. This discussion is divided into two sections: (a) teachers' beliefs about technology and their practices of technology integration and (b) external factors influencing teachers' beliefs.

Teachers' beliefs about technology and their practices of technology integration. Teachers' beliefs about the role of technology affect their integration. Research suggests that teachers with student-centered beliefs are more likely to integrate technology and teacher-centered beliefs can negatively impact integration (Hermans et al., 2008). Teacher responses to the survey revealed more teacher-centered beliefs and practices among faculty than student-centered ones. For instance, the most frequent use of technology by students was for drill and practice/learning games ($M = 2.96$, $SD = 1.17$). The two most frequent uses of technology by teachers were communication with parents ($M = 4.32$, $SD = 1.13$) and presentations during instruction ($M = 3.71$, $SD = 1.15$). Additionally, mean scores for the section on the Importance of Technology in Teaching and Learning revealed teachers placed higher importance in the use of technology for teaching ($M = 4.07$, $SD = 0.79$) than learning ($M = 3.94$, $SD = 0.80$). The lowest mean scores from this section came from the statements “Students’ use of technology in the classroom is important for knowledge construction” ($M = 3.46$, $SD = 0.79$) and “Using technology improves student comprehension and promotes higher-level thinking” ($M = 3.54$, $SD = 0.69$), which both relate to student learning. These findings suggest that teachers at the school used technology more for teacher-centered instruction and teachers perceived that student use involved low-level thinking skills, which aligns with previous research findings (Dawson, 2012; Palak & Walls, 2009; Polly & Rock, 2016).

Qualitative inquiry of interview and observation data revealed teachers’ beliefs differed by their levels of integration. Experienced integrators were identified as such because mean scores of their survey responses placed them at the upper end of the fourth quartile (3.83 – 4.49). Their responses on the Importance of Technology in Teaching and Learning section of the survey averaged 5.0 and 4.32, which was above the mean score of 4.0 ($SD = 0.80$). The two experienced integrators demonstrated more student-centered aspects in their lessons, such as providing students with choice and connecting content to real-world scenarios. They made statements regarding technology being essential to their practice during interviews. Furthermore, experienced integrators demonstrated robust technology use during their observations. These findings support previous research that teachers with more student-centered beliefs demonstrate more seamless integration of technology (Kim et al., 2013) and positive value beliefs toward technology (Hsu, 2016; Taimalu & Luik, 2019).

Novice integrators, by contrast, displayed teacher-centered characteristics during lessons, such as drill and practice activities and direct instruction. Their mean responses to the Importance of Technology in Teaching and Learning section of the survey were below the mean score (M = 4.0, SD = 0.80) at 3.53 and 3.68, falling between Neutral and Agree. Observations and interviews revealed they frequently used technology to provide a visual for students, which often involved using presentation software. Novice integrators expressed beliefs that technology was a supplemental piece of their instruction and could be used to support their lessons. They viewed technology as an extra component that could be added into their instruction but was not necessary. These findings concur with previous research indicating traditional teacher-centered beliefs negatively impact technology use (Hermans et al., 2008).

External factors influencing teachers' beliefs. Research has found teachers' beliefs are influenced by external factors. For example, Hew and Brush (2007) found subject culture to be a barrier to integration because teachers are hesitant to adopt technology that they perceive goes against the norms of the subject culture. Tondeur et al. (2017) identified school context as an important variable influencing teachers' pedagogical beliefs. They cite school characteristics such as policy planning, technology support, and peer support as falling within the realm of the school context (Tondeur et al., 2017). Both of these findings suggest external factors within the school environment impact teachers' beliefs, and this study provides further evidence.

In this study, the school culture impacted teachers' beliefs about the role of technology for instruction of students with dyslexia. One aspect of the school culture that shaped teachers' beliefs was the emphasis on multisensory methods of instruction. All teachers relayed the importance of multisensory methods in their interviews, and these instructional methods were observed in their classroom practices. Teachers varied in their beliefs about how multisensory methods and technology could work together during instruction. For instance, novice integrators viewed multisensory methods as preferable to instruction that involved technology. Conversely, intermediate and experienced integrators recognized that technology could provide a multisensory component. Despite this variety, teachers viewed phonics instruction in particular as an area where technology could not replace multisensory methods. For example, when asked about using technology for instruction, Amelia, an experienced integrator, responded:

> Not so much in phonics. In phonics we'll do maybe one Smartboard game where they're able to either write letters or sounds on the board or they drag sounds or a game show, but all the rest of the day I'm using technology.

Amelia was a robust technology user, but she perceived technology use during phonics instruction as going against the school norm of multisensory phonics instruction. This aligns with Hew and Brush's (2007) finding that teachers resist adopting technology they perceive as contradicting the norms of the subject culture. Similarly, Sophia, a novice integrator, stated when asked about the role of technology: "I don't think it will ever replace one-on-one instruction because with our model of hands-on learning that is what our population seriously needs." Sophia's statement expresses the belief that multisensory instruction is a key element of reading remediation for students with dyslexia. Regardless of their varying views on how technology can be combined with multisensory methods, the use of multisensory methods is a deeply ingrained school norm. The influence of this aspect of our school culture was evident in teachers' statements regarding finding balance between technology use and multisensory methods.

Distance learning was another factor affecting teachers' beliefs. Due to COVID-19, the school instituted a policy requiring teachers to instruct students in a virtual environment. Teachers were thrust into distance learning with little time to train or prepare for their new online classrooms. This experience impacted teachers' beliefs about technology, which supports Tondeur et al.'s (2017) findings that school context plays a part in shaping teachers' beliefs. Furthermore, in a longitudinal perspective, five teachers in this study expressed changes in their beliefs about technology after the experience of distance learning, which supports previous research findings that teachers' beliefs changed after participating in a technology-rich environment (Levin & Wadmany, 2006, 2008), such as distance learning (Barbour & Reeves, 2009). However, teachers' experiences with and perceptions toward distance learning were personalized, and this was reflected in their changing beliefs.

For novice integrators and one intermediate integrator, being immersed in the technology-rich environment provided by distance learning helped them identify new uses for technology. Prior to distance learning, Olivia and Sophia's beliefs about the importance of technology for teaching and learning fell in the range of Neutral ($M = 3.68$ and $M = 3.53$, respectively). After three months of teaching online, Olivia said about technology, "I didn't see the need as much before and now I feel like there's a much greater need in every aspect of teaching to be able to use technology." She realized technology was needed in a way she had not recognized before. Similarly, Emma, an intermediate integrator, found new uses for technology that replaced paper and pencil tasks. For example, her students completed worksheets in Seesaw and were able to record themselves reading the words to her. Teachers also identified new ways to use technology that increased their personal productivity. For instance, Sophia, a novice integrator, began using a Google Doc to create lesson plans that she could share with her co-teacher. Emma, an intermediate integrator, found an online lesson plan book that allowed her to streamline her lesson planning process. She also expressed the ease with which she could share lessons with her co-teacher. These changes in teachers' classroom practices reflected changes in their beliefs about technology. These findings support Levin and Wadmany's (2006, 2008) findings that teachers' beliefs and practices changed after participating in a technology-rich environment.

For the experienced integrators, their beliefs also changed. They reported high levels of technology use for students and themselves on the adapted STIR. Rachel's mean scores for technology use were 3.50 for students and 3.57 for teachers, which aligns with more than once per week and approaching several times per week. Similarly, Amelia's use was reported to be 4.0 for students and 4.29 for herself, indicating she and her students used technology several times per week. In both of their initial observations, Rachel and Amelia used technology extensively. However, in each of their final interviews, they expressed concern over how much technology students were using. For Rachel, her concern was centered on students' screen time. She stated, "some days we're just going to do paper and pencil, [and] we're not going to get the iPad out today because we've been looking at a screen all day." For Amelia, using technology throughout the day in all subjects lost novelty for her and her students. She noted, "we wouldn't do digital things in phonics, but now it's all [digital], now the whole school day is digital, whereas it used to just be math and social studies, so they weren't used to it." These changes in teachers' beliefs provide support for Levin and Wadmany's (2006, 2008) findings that teachers' beliefs evolve. Furthermore, Levin and Wadmany (2006, 2008) found that the process of educational change involving technology was unique to each teacher. This study corroborates those findings as each integrator experienced unique changes in their beliefs based on their own individual circumstances.

Research Question 2: What are new online teachers' perceived barriers to technology integration at a school for students with dyslexia?

Teachers face many obstacles when attempting to integrate technology. Research has identified both first- and second-order barriers affect technology integration (Jones, Smith, & Cohen, 2017; Petko, 2012; Wachira & Keengwe, 2010). In this study teachers faced both kinds of barriers, but they experienced more first-order barriers than second-order barriers. Additionally, Ertmer (1999) suggested teachers' perceptions of barriers can impact their technology use. The discussion of the perceived barriers teachers faced is divided into the following sections: (a) first-order barriers, (b) second-order barriers, and (c) relationship between barriers.

First-order barriers. All teachers in this study experienced first-order barriers, which supports previous research findings that external barriers hinder technology integration (An & Reigeluth, 2011; Francom, 2016; Wachira & Keengwe, 2010). All six teachers faced obstacles relating to time, such as the time it takes to learn new technology. Three teachers found access to reliable and updated technology was a barrier. Finally, two teachers identified their co-teachers' beliefs as a barrier to their integration.

Findings from this study support previous findings that time serves as a significant barrier to integration (An & Reigeluth, 2011; Francom, 2016; Hew & Brush, 2007; Hsu, 2016). Survey results indicated teachers' perceived time to be a barrier. The most significant first-order barrier items from the survey were "Teaching students how to use technology takes much of classroom time" (M = 3.54, SD = 1.10) and "Learning to use technology for instruction is time-consuming" (M = 3.36, SD = 1.06). Additionally, all six participants identified time as a barrier during interviews and elaborated on the ways it hindered their technology integration. Namely, teachers felt it took time to learn new technology, to implement technology into lessons, and to teach students how to use technology, concurrent with quantitative findings. Teachers also identified barriers related to time that were specific to our school context. For instance, they mentioned the time spent distributing devices to students and collecting devices after use since they are stored in a central location within most classrooms rather than at students' desks. Time spent logging into accounts was also a reason teachers avoided using technology.

Access to technology is another external barrier that has been identified in the literature (Francom, 2016; Wachira & Keengwe, 2010). Previous studies found access was a barrier when technology was not available (Francom, 2016) or not easily accessible to teachers (Wachira & Keengwe, 2010). Teachers expressed agreement in their survey responses that hardware (M = 4.50, SD = 0.57) and software (M = 4.54, SD = 0.51) were available to them and their students. However, interviews revealed both experienced integrators and one novice integrator encountered access as a barrier when technology was not updated or not working properly. The most frequently cited unreliable technology was classroom Smartboards that did not work. For example, Amelia noted during her first interview, “the Smartboard was a real issue for us last year....there was one day where the Smartboard decided to just not even turn on.” Software not being updated also prevented teachers from using technology. During her second interview, Amelia stated, “during distance learning my Smart Notebook wasn’t updated….I had to email back and forth with [the IT department] to then have them come take over my screen in order to fix it.” These findings suggest that increasing the number of devices available to teachers does not eliminate access being a barrier. Rather, devices must be maintained in order to ensure teachers have access to hardware and software that are reliable and functioning properly.

Previous research has identified other teachers’ beliefs as a significant barrier to integration (Ertmer et al., 2012). Two teachers in this study found their technology integration was hindered by their co-teachers, which supports these previous findings (Ertmer et al., 2012). Amelia, who was an experienced integrator, detailed the frustration she felt because her co-teacher's beliefs about the role of technology hindered her use. Similarly, Sophia, a novice integrator, relayed that her co-teacher did not have a positive attitude toward technology and was not comfortable with significant technology use in their classroom. Her co-teacher's feelings kept her from integrating technology at times. The school context of having two teachers in a classroom lends itself to situations such as these. Historically, the two classroom teachers held different positions where one teacher was considered the lead teacher and the other one was the associate teacher. This dynamic created a hierarchical classroom structure where the lead teacher’s beliefs and practices dominated the classroom. Research into co-teaching methods in inclusive classrooms has found similar results where one teacher plays a more supportive role (Brouck, 2007; Magiera, Smith, Zigmond, & Gebauer, 2005; Scruggs, Mastropieri, & McDuffie, 2007). Brouck (2007) described tensions created by the co-teacher dynamic, such as decreased teacher autonomy and constrained teacher roles as well as feelings of being devalued. The co-teacher dynamic in Amelia's and Sophia's classrooms demonstrated this tension. Because their co-teachers did not share their beliefs about the role of technology, they experienced decreased their teacher autonomy when attempting to integrate technology.

Second-order barriers. Second-order barriers describe those internal to teachers, such as their beliefs about the role of technology in teaching and learning, their willingness to change, and their technological knowledge. Previous research into technology integration has found second-order barriers can significantly impede integration (Gu et al., 2013; Hermans et al., 2008; Hew & Brush, 2007; Jones et al., 2017; Wachira & Keengwe, 2010). In this study, both novice integrators and one intermediate integrator experienced second-order barriers.

Research has found teachers' beliefs can serve as a barrier to technology integration (Gu et al., 2013; Hermans et al., 2008; Hew & Brush, 2007; Jones et al., 2017). Two teachers in this study expressed beliefs about the role of technology that affected their use of it. Sophia and Olivia stated that they viewed technology as a supplement to integration. As such, they did not see the need to use technology to aid student learning. Furthermore, Olivia and Sophia believed multisensory methods were preferable to technology use. These beliefs affected their use of technology in their classrooms, supporting the previous research (Gu et al., 2013; Hermans et al., 2008; Hew & Brush, 2007; Jones et al., 2017).

Lack of technological knowledge was a significant barrier for novice integrators. Previous studies support this finding (Hew & Brush, 2007; Hsu, 2016; Jones et al., 2017; Wachira & Keengwe, 2010). Teachers are not likely to use technology in their classrooms if they lack the knowledge to use it. Olivia confirmed, "If I don't know how to do [something with technology], then I'm just not gonna expose the class to it." Her lack of knowledge prevented her from using technology, and she admitted this was the greatest barrier for her. Similarly, Sophia's knowledge prevented her from using technology. She stated, "that kind of held me back and I just didn't think I had the expertise in some of [the technology]." Olivia and Sophia used tools that were familiar to them, and this resulted in limited technology use.

Teachers' beliefs and technological knowledge can affect one another (Hew & Brush, 2007). For example, previous studies found teachers' lack of technological knowledge affected their confidence in using tools (Gu et al., 2013; Holden & Rada, 2011; Vareberg & Platt, 2018). This was evident with the two novice integrators in this study. For Olivia and Sophia, the fear of technology failing during a lesson and not having the technological knowledge to troubleshoot decreased their self-efficacy beliefs. Olivia stated, "with technology, I often feel like [I'm] taking a risk and if something happens and it doesn't work, I don't have a good fallback, troubleshooting, knowing what to do when technology suddenly doesn't work." Sophia also lacked confidence in her ability to troubleshoot problems. She stated, "I think the fear comes in and I'm like 'Oh, I don't know, I'm going to mess this whole thing up because I don't feel confident enough in my training and my ability to do it.'" For these two teachers, fear of technology failing and not knowing how to recover prevented them from using technology.

Relationship between barriers. The relationship between first- and second-order barriers is complex. When Ertmer (1999) outlined first- and second-order barriers, she noted that differences in how teachers perceive first-order barriers can determine higher levels of technology use. Furthermore, she suggested that teachers' pedagogical beliefs and classroom practices can affect how they perceive first-order barriers and the relative weight they assign to these barriers (Ertmer, 1999). Findings from this study seem to show evidence of this. For example, experienced integrators demonstrated strong technological knowledge; however, one barrier they faced was time. Both experienced integrators stated in interviews they occasionally ran out of time to implement technology into their lessons. This instance of time as a barrier did not align with the reasons time served as a barrier for the other teachers in this study. Additionally, experienced integrators stated they were able to incorporate the technology in later lessons. For example, Rachel stated, "we've run out of time to incorporate more technology into the lesson, but we kind of bring it in the next day or shift plans around." Their strong technological knowledge allowed them to easily make changes to when and where they integrated technology into their lessons. Thus, time served as an immediate barrier to integration during lessons, but it did not carry much weight as they were ultimately able to integrate technology at a later time.

Research into strategies to overcome barriers has highlighted how teachers' beliefs and practices can reduce barriers they face (Ertmer et al., 2012; Walker & Shepard, 2011). Studies have found teachers' technological knowledge and confidence in their abilities allowed them to overcome barriers (Ertmer et al., 2012; Heath, 2017; Walker & Shepard, 2011). Both experienced integrators demonstrated strong technological knowledge during their observations. Additionally, their technological knowledge allowed them to troubleshoot issues that arose during lessons. For example, during her second observation, Amelia's distance learner was having trouble logging into Pear Deck. She suggested a few things for him to try that might have been causing the error. After he struggled for a few minutes, she pivoted to using Zoom's annotate feature for him to share his answers. Her strong technological knowledge in this situation helped her quickly shift to a different tool after her attempts to troubleshoot were unsuccessful. This swift action on her part prevented access from becoming a barrier. Both experienced integrators were confident in their knowledge and ability, which enabled them to use technology without fear of it failing. Their strong technological knowledge reduced barriers they might have faced such as access and technical support.

Research Question 3: How do new online teachers' observed classroom practices align with their stated beliefs about technology?

Researchers have examined teachers' alignment of beliefs and practices with mixed results. Some have found teachers' espoused beliefs aligned with their classroom practices (Ertmer, 2005; Fives & Buehl, 2013). Others have noted teachers' beliefs were not in alignment (Chen, 2008; Liu, 2011; Mama & Hennessy, 2013; Polly & Hannafin, 2011; Shifflet & Weilbacher, 2015). This study sought to determine if teachers' beliefs aligned with their classroom practices. Interviews and classroom observations informed this research question.

Teachers hold varying degrees of student-centered and teacher-centered beliefs. A meta-analysis of research into teachers' pedagogical beliefs found teachers held multiple beliefs and approaches to technology that did not fit entirely in one category (Tondeur et al., 2017). These varying beliefs can be reflected in their classroom practices. Two previous studies found teachers exhibited both traditional and constructivist classroom practices (Orlando, 2013; Shifflet & Weilbacher, 2015). Five teachers in this study did not describe their beliefs as fitting clearly into one category or the other. For example, when asked about their pedagogical beliefs, teachers gave the following responses:

Amelia: I am almost an aspect of both….I would say it's more student-centered because I may have a lesson, but it completely has changed based on what the students are understanding or not understanding.

Rachel: I would definitely lean more student-centered because I think if they're more engaged and they're taking charge of their learning, then it's going to be a lot more relevant for them and they're going to be more excited about it.

Charlotte: I would say presently I am teacher-centered but moving towards student-centered. I think sometimes [instruction] needs to be teacher-centered at one point in order for students to have the support they need for it to be student-centered, sort of a gradual release.

Emma: I probably fall somewhere in the middle of [teacher-centered and student-centered]. If I think about the population of students that we teach, and with our Orton-Gillingham training, we need to be very explicit in our teaching because I think it's proven that if we're not it's going to be more difficult for these students in particular to learn the content. I think that it's important for there to be that exploratory time too.

Olivia: I would say that I'm definitely coming from teacher-centered, but I think the better way to go is of course student-centered.

Sophia: I'm pretty in the middle [of teacher-centered and student-centered] I would think. I think that you should be prescriptive and diagnostic in your teaching, and that really depends on how you're interacting with the child.

Olivia was the only teacher who took a strong stand labeling her beliefs teacher-centered. All other teachers described their beliefs as being between student-centered and teacher-centered to some degree.

Some studies have found teachers' beliefs aligned with their classroom practices (Ertmer et al., 2012; Hsu, 2016). Four teachers in this study demonstrated alignment of their stated beliefs and classroom practices, supporting these findings. Amelia, an experienced integrator, said her beliefs contained aspects of both student-centered and teacher-centered practices, and classroom observations revealed this to be true. During lessons, she had students problem solve and work on interactive tasks, but she wove independent learning tasks in her lesson as well. Rachel, also an experienced integrator, expressed more student-centered beliefs during her first interview. However, after distance learning she stated her pedagogical beliefs had changed as she grew concerned about students' screen time. This change was reflected in her second observation which contained mostly teacher-centered characteristics, such as students completing tasks individually and incorporating activities that tapped remembering information. Charlotte, an intermediate integrator, showed alignment between her beliefs and practices. She stated her beliefs had changed to being more teacher-centered since coming to the school. Observations in her classroom revealed teacher-centered instruction that was primarily didactic. Olivia, a novice integrator, recognized her beliefs as teacher-centered, which matched her instruction. She delivered direct instruction, presented information to students, and had them engage in independent learning.

Research has also shown teachers' beliefs are not always in alignment with their practices (Chen, 2008; Liu, 2011; Mama & Hennessy, 2013; Polly & Hannafin, 2011; Shifflet & Weilbacher, 2015). One intermediate integrator and one novice integrator displayed misalignment between their beliefs and practices. Emma and Sophia felt their beliefs were in between student-centered and teacher-centered, but their instruction was teacher-centered. For example, Emma's observations were primarily didactic with students completing independent learning activities that promoted storing and remembering information. During Sophia's first observation, she presented information to students through direct instruction. Her second observation included a few student-centered characteristics, such as interactive learning activities. However, most of her instruction contained teacher-centered characteristics, such as direct instruction and presenting information.

Previous research provides a few reasons why teachers' beliefs are misaligned with their practices (Chen, 2008; Liu, 2011; Orlando, 2013). Orlando (2013) found some teachers felt the curriculum dictated teacher-centered instruction. Two teachers in this study made statements expressing the belief that phonics required teacher-centered methods. For example, Emma said, "most certainly with the population of students that we teach, if we weren't providing the explicit instruction, [students] wouldn't make the gains that we see they can make." Additionally, Emma, Charlotte, and Olivia were observed during phonics lessons, and they all displayed teacher-centered characteristics in their instruction. Chen (2008) suggested teachers may not fully understand pedagogical beliefs in order to accurately describe their own. This could explain why Emma's and Sophia's stated beliefs did not align with their observed practices. During our first interview, Emma asked for clarification about what was meant by teacher-centered and student-centered when asked to describe her pedagogical beliefs. Sophia's response to the question about her pedagogical beliefs was contradictory. She stated her beliefs were in the middle, but as she elaborated, she described teacher-centered beliefs with statements such as, "there has to be a level of trust and respect that is established first and that they see you as a teacher." For these teachers, not fully understanding pedagogical beliefs may have been the reason they stated their beliefs were in-between student-centered and teacher-centered.

Implications

Findings from this research have many implications. Since the goal of action research is continuous improvement, these research findings have generated recommendations to help mitigate the problem of practice within my school that teachers are not effectively integrating technology (Mertler, 2017). On a personal level, I have been impacted as a researcher by gaining experience conducting action research, which influences my role at the school. Finally, this research lends itself to continued cycles of action research as well as future areas of study. The discussion of implications is divided into the following sections: (a) implications for practice, (b) personal implications, and (c) future implications.

Implications for Practice

The findings from this research study add to the existing literature on technology integration and online learning. The longitudinal nature of this study revealed teachers' beliefs about technology changed over time through the distance learning experience. All teachers at the school were thrust into an online teaching environment without having any prior experience and with minimal training. Teachers learned new uses for technology for their students and themselves. They also recognized technology use must be purposeful and carefully planned so that reliance on technology is not too great.

Finding from this research study also provide several implications for the school. Professional development is recommended to address gaps and deficiencies in teachers' technological knowledge. Given the significant role of pedagogical knowledge, content knowledge, and technological knowledge in technology integration (Koehler & Mishra, 2009), professional development should focus on building teachers' TPACK. Due to the school norm of providing multisensory instruction, professional development that provides teachers ways to marry multisensory methods with technology is advised. Additionally, steps can be taken to reduce first-order barriers that teachers in this study identified.

Professional development. Research has shown that professional development can positively impact technology integration (Cifuentes et al., 2011; Coleman et al., 2016; Ertmer et al., 2006; Vannatta & Fordham, 2004). Furthermore, professional development can help shape teachers' beliefs, which could reduce second-order barriers (Ertmer, 2005; Ertmer & Ottenbreit-Leftwich, 2010; Ertmer & Ottenbreit-Leftwich, 2013). Effective professional development needs to be job-embedded, on-going, hands-on, and focus on academic content (Garet, Porter, Desimone, Birman, & Yoon, 2001). Additionally, it should provide technical knowledge and authentic learning experiences (Ertmer & Ottenbreit-Leftwich, 2010; Ertmer et al., 2015). Therefore, professional development is recommended that addresses (a) building teachers' TPACK and (b) integrating multisensory instructional methods with technology.

Building teachers' TPACK. Many teachers at the school would benefit from training on the technology tools available to them. Training should not only build teachers' technical skills, but also show them how technology can be used to enhance content and what pedagogical approaches best support technology use. The recommended approach to build teachers' understanding of the interplay between content knowledge, pedagogical knowledge, and technological knowledge consists of three delivery methods: (a) mentoring, (b) technology training, and (c) vicarious learning experiences. The goal of these methods is to increase teachers' knowledge of instructional tools and methods while also building their confidence in their ability to integrate technology.

Mentoring. Survey results showed the majority of teachers at the school are using technology for teacher-centered uses. Four of the six teachers who participated in the qualitative phase demonstrated teacher-centered instructional practices during their observations. Research has shown professional development helped shift teachers' pedagogical practices to more student-centered instruction (Levin & Wadmany, 2006; Polly & Hannafin, 2011). Therefore, professional development in the form of mentoring is recommended to provide teachers with the knowledge needed to implement more student-centered instructional approaches into their classrooms. Specifically, mentoring should be designed to build teachers' technological pedagogical knowledge (Koehler & Mishra, 2009). Kopcha (2010) outlined a mentoring system where teachers move through four phases of technology adoption in order to learn how to use technology in more student-centered ways. It is recommended that the school implement a similar mentoring system where one teacher in each grade level serves as the technology mentor. That teacher will be available to assist others in the grade with technical help as well as instructional ideas. The mentor will also be tasked with sharing ideas for technology integration during grade level meetings. In this way, grade levels will serve as communities of practice where instruction tools and methods are shared among peers (Cifuentes et al., 2011; Kopcha, 2010). By sharing in grade level meetings, teachers can also build their technological content knowledge to better understand how technology can influence and constrain their content (Koehler & Mishra, 2009).

Technology training. Survey results showed teacher technology use fell in the range of once per week (M = 3.26, SD = 1.49) while student technology use fell in the range of once per month or less (M = 2.70, SD = 1.26). Qualitative data revealed lack of technological knowledge was a barrier to integration for three teachers who were relatively lower technology integrators. To further increase the technological knowledge of teachers at the school, it is recommended that workshops teaching how to use technology are offered on a regular basis. Previous research has found professional development focusing on teachers' technical skills also increased their comfort with technology (Makki et al., 2018; Walker & Shepard, 2011). The main goal of these workshops will be to provide basic training of the instructional tools available to teachers within the school context in order to increase their comfort in using these tools. These workshops should be hands-on and use content relevant to the school in order to help teachers connect how the technology could be used within their practice (Garet et al., 2001).

Vicarious learning experiences. Teachers' beliefs were found to be a barrier to integration for two teachers in this study. Furthermore, their lack of technological knowledge decreased their self-efficacy beliefs. Building teachers' confidence in using technology is crucial because research findings show self-efficacy is a predictor of technology use (Gu et al., 2013; Holden & Rada, 2011; Li et al., 2016), and high self-efficacy can motivate teachers to use technology (Cullen & Greene, 2011). Research supports vicarious learning experiences as successful professional development because they allow teachers to see others effectively using technology and can increase their self-efficacy in completing similar tasks (Wang, Ertmer, & Newby, 2004). Additionally, vicarious learning experiences can motivate teachers to use technology because they capture the impact of technology on student learning (Ottenbreit-Leftwich et al., 2010). Filming teachers who demonstrate effective uses of technology provides a practical way for teachers to learn vicariously from others. It is recommended that such videos be collected and stored in an online library accessible to all teachers. These videos will serve to highlight teachers' technological pedagogical knowledge in order to help teachers visualize how technology impacts their pedagogical choices (Koehler & Mishra, 2009). Additionally, videos from this library can be used to support mentoring and technology workshops.

Integrating multisensory instructional methods with technology. All teachers in this study stated the importance of multisensory instruction for students with dyslexia. Furthermore, the instructional approach used by the school emphasizes multisensory methods as a key strategy for reading remediation (Orton-Gillingham Academy, 2018). Given the significant importance placed on multisensory instruction, professional development should address ways teachers can use technology to incorporate multisensory methods. The schools' internal teacher training course has begun to address this. However, only teachers hired in the last couple of years have received professional development combining multisensory methods with technology. Creating an additional teacher training course for veteran teachers where instructional multisensory methods using technology are modeled is recommended. This course could be a shortened, asynchronous version of the original course to provide access to the material without being redundant to the course teachers have already taken. Using phonics content relating to the Orton-Gillingham Approach will create meaningful, authentic learning experiences for teachers (Ertmer & Ottenbreit-Leftwich, 2010; Ertmer et al., 2015). Additionally, this course will build teachers' technological content knowledge by showing teachers ways to use technology with their phonics content (Koehler & Mishra, 2009).

Recommendations to reduce first-order barriers. All teachers in this study experienced first-order barriers. First-order barriers are external to teachers and often out of their control (Ertmer, 1999). Therefore, action steps to reduce first-order barriers are recommended. The following paragraphs outline recommendations to reduce the barriers of (a) time, (b) teaching partnerships, and (c) access.

Time. All teachers mentioned time as a barrier to integration, which is consistent with previous research findings (An & Reigeluth, 2011; Francom, 2016; Hew & Brush, 2007; Hsu, 2016). The time spent logging onto devices and distributing devices was a frustration for several teachers. Usernames at the school are created by concatenating the first two letters in students' first name with their last name. Students in kindergarten through second grade have not learned letter placement on a Qwerty keyboard, so typing long strings of letters is time-consuming. Researching ways to minimize login time is recommended. For example, single sign-on options can facilitate the login process. Since all students have Google logins, using this option to log in can save students time by not having to type their email and password. Additionally, single sign-on software such as Clever can streamline the login process and save class time. Teachers also felt valuable instructional time was spent distributing devices to students. Reducing the time spent distributing technology could be accomplished by organizing the classroom differently or assigning a student or the co-teacher to pass out technology in the morning.

Teaching partnerships. Co-teachers' beliefs were a significant barrier for two teachers in this study. Prior studies also found other teachers' beliefs were obstacles to teachers' integration of technology (Ertmer et al., 2012). Given the school's arrangement of two teachers in every classroom, careful consideration of teaching teams is recommended. While many factors are weighed when choosing to pair two teachers, it is suggested that teachers' beliefs about the role of technology for teaching and learning be included as well. Additional training on the different co-teaching models could also benefit teaching teams by introducing or reviewing teaching models that demonstrate an equal working relationship (Cook & Friend, 1995).

Increasing access. Several teachers identified access as a barrier to their integration of technology. Previous studies confirm access can be a barrier to integration when technology is not available or unreliable (Francom, 2016; Wachira & Keengwe, 2010). Findings from this study revealed lack of access related to software that was not updated or not installed and hardware that was unreliable. Several systems could be implemented in order to improve teachers' access to technology. First, teachers could be trained on how to determine software versions they are using and how to install software updates. Since many faculty use the same software, the IT manager could send a reminder email to teachers when updates are necessary. Finally, it is recommended that the IT department periodically review teachers' devices to ensure they are running current software and have made the required updates. To ensure hardware is reliable, the IT department should maintain a detailed life cycle plan to ensure devices are not employed beyond their usable life (Michael, 1998). The helpdesk ticketing system should be reviewed for frequent complaints about the same devices to determine if repair or replacement is warranted (Michael, 1998).

Personal Implications

In addition to implications for practice, the findings from this research study have personal implications. Conducting action research was an influential experience that showed me how I can continue to improve my own practice as well as help others improve their practice. These research findings are guiding work in my current role at the school by providing a path forward with next steps and lending insight to how I can help increase teachers' integration of technology. Finally, using TPACK as the framework for this action research study helped me better understand each of the knowledge domains required for effective integration. The following sections are addressed below: (a) reflection on action research, (b) reflection on mixed methods, (c) insights for my current role, and (d) future implications.

Reflection on action research. Learning about action research methodology has provided me with the knowledge and skills to continue conducting research around my school to help identify and improve problems of practice. It has taught me to critically examine my practice to identify problems and seek solutions based in research but grounded in practice (Mertler, 2017). It has shown me that practitioners, such as myself, can affect change at a local level. These changes could involve the training we offer to teachers, provide improved instructional methods in the classrooms, and identify better methods to assess students, to name a few. My school's culture emphasizes continuous improvement, and action research will be a valuable part of that ongoing cycle of improvement.

Reflection on mixed methods. This study utilized quantitative and qualitative methods in order to provide a more complete understanding of teachers' beliefs, practices, and barriers regarding technology integration (Creswell, 2014). Using mixed methods gave me experience collecting and analyzing quantitative and qualitative data. It provided me with a deeper understanding of the types of information to be gained from each method. For example, quantitative data can be used to identify trends, attitudes, or opinions from a sample population (Creswell, 2014). I developed a better understanding of the state of technology integration within my school through the process of collecting and analyzing survey data. Descriptive statistics revealed disparity in how frequently teachers were using technology, but also that teachers generally agreed that technology was important for teaching and learning. Qualitative data collection allows researchers to learn about how individuals interpret their experiences and the meaning they attribute to those experiences (Merriam & Tisdell, 2016). By interviewing teachers who represented three different levels of technology integration, I was able to understand multiple perspectives about the role of technology and their practices integrating technology into their classrooms. I gained experience using several different methods of coding to analyze my qualitative data, and this practice helped me better understand how systematic analysis of qualitative data can provide rigor. Multiple rounds of coding of the qualitative data produced themes that provided insights into teachers' beliefs about the role of technology in teaching and learning and the barriers they faced when trying to integrate technology. Their voices told their stories and contributed to the larger story of technology integration at the school. By merging the quantitative and qualitative data collected, I was able to make interpretations about how teachers' beliefs influenced their technology use and their perceptions of barriers to integration.

Insights for my current role. Integrating technology was one of the goals of the school's current strategic plan, and this research provided me with a better understanding of where teachers are in the process of integrating technology. Survey responses, teacher interviews, and classroom observations have shown me the range of perceptions people have about the role of technology in teaching and learning. Understanding these perceptions allows me to develop training specifically targeting the skills and knowledge teachers need. It also allows me to serve as a coach to teachers who need more support integrating technology in their classrooms. By modeling effective integration, observing teachers, and providing targeted feedback, I can help increase their confidence and comfort in using technology tools.

This research helped identify the specific barriers that exist within my school context. Some of the identified barriers can be reduced or eliminated with minimal effort, such as helping teachers create new routines for distributing devices that can save time. Other barriers, such as teacher's beliefs about multisensory methods, are deeply rooted in our school context. However, recognizing this is a barrier for some teachers allows me to provide training specific to their needs. Understanding teachers' beliefs was also helpful for me to know how those beliefs were impacting their integration. For instance, fear of failing in front of her students was a real concern for Sophia. Knowing this, she is a good candidate for coaching to build her confidence in using technology.

Finally, this research provided me with a better understanding of TPACK as it relates to teachers in my school context. I saw firsthand the important role technological knowledge plays, namely how it encompasses not only the skills to use tools, but an understanding of how those tools affect your practice and your content. Experienced integrators were skillful at using technology and demonstrated knowledge that translated across different technologies. Their deep technological knowledge allowed them to seamlessly integrate technology, troubleshoot when something was not working, and easily shift to a new tool if needed. Having strong technological knowledge also increased their self-efficacy and reduced their fear of trying new things. Lacking technological knowledge was a significant barrier for some teachers, but it also contributed to their apprehension using technology.

Future Implications

Action research is a cyclical process, and more information can be gained from additional cycles (Mertler, 2017). Since the adapted STIR was completed by teachers before distance learning began, the next cycle of action research could explore teachers' responses now that they have experienced distance learning. Surveying participants multiple times can capture changes in teachers' beliefs, technology use, or barriers they experienced (Coughlan, Cronin, & Ryan, 2009). For example, results from the survey could gauge how distance learning has impacted teachers' beliefs about the role of technology for teaching and learning. Additionally, the school has invested in many new digital resources to assist teachers with virtual instruction. The survey could identify which tools are the most useful to teachers and students in the distance learning environment and identify which barriers to integration still exist.

Opportunities for new action research studies have also been generated by this study. Distance learning created new opportunities for the school. For example, the school invested in technology to aid distance learning (e.g., a Zoom subscription) as well as digital resources. A future action research study could examine teaching and learning in the digital environment with an emphasis on identifying pedagogical strategies for online learning that work well with the Orton-Gillingham Approach. Another opportunity for action research relates to the school's co-teaching model. The school is currently redefining teachers' roles in the classroom in an effort to move away from the hierarchical structure previously employed. Interviewing teachers and observing their classroom practices could lend insight to the elements that make a teaching team successful.

Limitations

As with the majority of research studies, the current study is subject to limitations. The action research methodology was selected to study a problem within a specific context to promote improvement of practice (Mertler, 2017). Therefore, the results of this study may not be generalizable to other contexts. While findings from this research support previous research on the role teachers' beliefs play in technology integration (Hermans et al., 2008; Inan & Lowther, 2010; Taimalu & Luik, 2019; Tondeur et al., 2017) and barriers they faced when integrating technology (An & Reigeluth, 2011; Ertmer, 1999; Hew & Brush, 2007; Wachira & Keengwe, 2010), the results should be considered in light of these limitations.

This study collected responses from participants through the administration of a survey, which presents a few limitations. Teachers self-reported their beliefs, attitudes, technology use, and perceptions of barriers they had encountered in the survey. Research into self-reported survey data has found it can reflect self-presentation bias and teachers may inaccurately report their own practices (Kopcha & Sullivan, 2007). The response rate for the survey was 51%, which is considered acceptable (Coughlan et al., 2009). However, it is possible the results do not accurately represent the school population due to individual non-responses (Coughlan et al., 2009). Additionally, several survey items contained higher alpha values when dropped than the overall alpha for that section. These items were kept because they contributed important quantitative data to answer the research questions, but this should be kept in mind when interpreting results. Finally, the survey was adapted from existing instruments rather than using an established instrument in its entirety. While the survey was reviewed by subject area experts and tested for internal consistency, further administration could improve the instrument (Coughlan et al., 2009).

Qualitative research methods also present their own limitations. In qualitative research, the researcher serves as a key instrument and is integral to the study (Creswell, 2014). As such, the researcher's own subjectivities can present biases in how findings are interpreted (Roulston & Shelton, 2015). It is important for qualitative researchers to recognize their biases and reflexively examine their interpretations to identify if assumptions are being imposed (Fischer, 2009). I kept a researcher's journal throughout the data analysis process to document my thoughts and emerging ideas as well as to self-examine my practices and assumptions (Roulston & Shelton, 2015). However, findings from this research should be viewed in light of this limitation.

Finally, restrictions due to COVID-19 placed limitations on this study. Namely, initial observations of teachers had to be conducted virtually. Observations allow researchers to examine participants' behavior and actions in their natural setting (Merriam & Tisdell, 2014). Observing students and teachers through video conferencing software limited how much I was able to view of their actions. For instance, I could not see what students were writing as they worked. Additionally, students did not always sit so the camera was capturing their face. Because younger students used Apple iPads, when they utilized apps in class while also using the video conferencing software, no image of what they were doing was available.

REFERENCES

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50*, 179-211.

American Psychological Association Work Group of the Board of Educational Affairs. (1997). *Learner-centered psychological principles: A framework for school reform and redesign.* Washington, DC: American Psychological Association.

An, Y., & Reigeluth, C. (2011). Creating technology-enhanced, learner-centered classrooms: K–12 teachers' beliefs, perceptions, barriers, and support needs. *Journal of Digital Learning in Teacher Education*, *28*(2), 54–62. https://doi.org/10.1080/21532974.2011.10784681

Archambault, L., & Crippen, K. (2009). Examining TPACK among K-12 online distance educators in the United States. *Contemporary Issues in Technology and Teacher Education, 9*(1), 71-88.

Archambault, L., & Larson, J. (2015). Pioneering the digital age of instruction: Learning from and about K-12 online teachers. *Journal of Online Learning Research*, *1*(1), 49–83.

Arnesen, K. T., Hveem, J., Short, C. R., West, R. E., & Barbour, M. K. (2019). K-12 online learning journal articles: Trends from two decades of scholarship. *Distance Education*, *40*(1), 32–53. https://doi.org/10.1080/01587919.2018.1553566

Barbour, M. K. (2012). Training teachers for a virtual school system: A call to action. In *Developing Technology-Rich Teacher Education Programs: Key Issues* (pp. 499–517). IGI Global. https://doi.org/10.4018/978-1-4666-0014-0.ch032

Barbour, M. K., & Harrison, K. U. (2016). Teachers' perceptions of K-12 online. *Journal of Educational Technology Systems*, *45*(1), 74–92. https://doi.org/10.1177/0047239516637072

Barbour, M. K., & Reeves, T. C. (2009). The reality of virtual schools: A review of the literature. *Computers and Education*, *52*(2), 402–416. https://doi.org/10.1016/j.compedu.2008.09.009

Blackwell, C. K., Lauricella, A. R., Wartella, E., Robb, M., & Schomburg, R. (2013). Adoption and use of technology in early education: The interplay of extrinsic barriers and teacher attitudes. *Computers and Education*, *69*, 310–319. https://doi.org/10.1016/j.compedu.2013.07.024

Bloomberg, L. D., & Volpe, M. (2016). *Completing your qualitative dissertation: A road map from beginning to end*. Thousand Oaks, CA: Sage.

Bouck, E. C., (2007). Co-teaching…not just a textbook term: Implications for practice. *Preventing School Failure, 51*(2), 46-51.

Bogdan, R. C. & Biklen, S. K. (1998). *Qualitative Research for Education: An Introduction to Theory and Methods* (3rd ed.). Boston, MA: Allyn and Bacon.

Brantley-Dias, L., & Ertmer, P. A. (2013). Goldilocks and TPACK: Is the construct "just right?" *Journal of Research on Technology in Education*, *46*(2), 103–128. https://doi.org/10.1080/15391523.2013.10782615

Brush, T., Glazewski, K. D., & Hew, K. F. (2008). Development of an instrument to measure preservice teachers' technology skills, technology beliefs, and technology barriers. *Computers in the Schools*, *25*(1–2), 112–125. https://doi.org/10.1080/07380560802157972

Chen, C. H. (2008). Why do teachers not practice what they believe regarding technology integration? *Journal of Educational Research*, *102*(1), 65–75. https://doi.org/10.3200/JOER.102.1.65-75

Cifuentes, L., Maxwell, G., & Bulu, S. (2011). Technology integration through professional learning community. *Journal of Educational Computing Research, 44*(1), 59-82.

Coleman, L. O., Gibson, P., Cotten, S. R., Howell-Moroney, M., & Stringer, K. (2016). Integrating computing across the curriculum. *Journal of Educational Computing Research*, *54*(2), 275–294. https://doi.org/10.1177/0735633115616645

Cook, L., & Friend, M. (1995). Co-teaching: Guidelines for creating effective practices. *Focus on Exceptional Children, 28*(3), 1-16.

Coughlan, M., Cronin, P., & Ryan, F. (2009). Survey research: Process and limitations. *International Journal of Therapy and Rehabilitation, (16)*1, 9-15.

Creswell, J. W. (2014). *Research design: Qualitative, quantitative, and mixed method approaches* (4th ed.). Thousand Oaks, CA: Sage.

Creswell, J. W. (2017). *Qualitative inquiry and research design: Choosing among the five traditions.* Thousand Oaks, CA: Sage.

Creswell, J. W., & Plano Clark, V. L. (2018). *Designing and conducting mixed methods research.* Thousand Oaks, CA: Sage.

Cuban, L., Kirkpatrick, H., & Peck, C. (2001). High access and low use of technologies in high school classrooms: Explaining an apparent paradox. *American Educational Research Journal, 38*(4), 813–834. https://doi.org/10.3102/00028312038004813

Cullen, T. A., & Greene, B. A. (2011). Preservice teachers' beliefs, attitudes, and motivation about technology integration. *Journal of Educational Computing Research*, *45*(1), 29–47. https://doi.org/10.2190/ec.45.1.b

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, *13*(3), 319-340. https://doi.org/10.2307/249008

Davis, N., Roblyer, M. D., Charania, A., Ferdig, R., Harms, C., Compton, L. K., & Cho, M. O. (2007). Illustrating the "virtual" in virtual schooling: Challenges and strategies for creating real tools to prepare virtual teachers. *Internet and Higher Education*, *10*(1), 27–39. https://doi.org/10.1016/j.iheduc.2006.11.001

Dawson, K. (2012). Using action research projects to examine teacher technology integration practices. *Journal of Digital Learning in Teacher Education*, *28*(3), 117–124. https://doi.org/10.1080/21532974.2012.10784689

Delgado, A., Wardlow, L., O'Malley, K., & McKnight, K. (2015). Educational technology: A review of the integration, resources, and effectiveness of technology in K-12 classrooms. *Journal of Information Technology Education: Research*, *14*, 397–416. https://doi.org/10.28945/2298

Deng, F., Chai, C. S., Tsai, C. C., & Lee, M. H. (2014). The relationships among Chinese practicing teachers' epistemic beliefs, pedagogical beliefs and their beliefs about the use of ICT. *Educational Technology and Society*, *17*(2), 245–256.

Denzin, N. K. (1973). *The research act: A theoretical introduction to sociological methods*. New Jersey: Transaction Publishers.

Desai, S. J. (2012). *Exploring middle school teachers' perceptions and applications of a site-based, technology-related professional development program focused on interactive whiteboards and classroom response systems* (Doctoral dissertation). Retrieved from ProQuest Dissertations & Theses Global. (1367177741).

Digital Learning Collaborative. (2019). Snapshot 2019: A review of K-12 online, blended, and digital learning. Retrieved from https://www.digitallearningcollab.com.

DiPietro, M. (2010). Virtual school pedagogy: The instructional practices of K-12 virtual school teachers. *Journal of Educational Computing Research*, *42*(3), 327–354. https://doi.org/10.2190/EC.42.3.e

DiPietro, M., Ferdig, R. E., Black, E. W., & Preston, M. (2010). Best practices in teaching K-12 online: Lessons learned from Michigan Virtual School teachers. *Journal of Interactive Online Learning*, *9*(3), 10–35.

Educational Collaborators. (2014). *Schenck School educational technology program audit report.* Sunset Hills, MO: Educational Collaborators.

Ertmer, P. A. (1999). Addressing first- and second-order barriers to change: Strategies for technology integration. *Educational Technology Research and Development, 47*, 47–61. https://doi.org/10.1007/BF02299597

Ertmer, P. A. (2005). Teacher pedagogical beliefs: The final frontier in our quest for technology integration? *Educational Technology Research and Development*, *53*(4), 25–39. https://doi.org/10.1007/BF02504683

Ertmer, P. A., & Ottenbreit-Leftwich, A. T. (2010). Teacher technology change: How knowledge, beliefs, and culture intersect. *Journal of Research on Technology in Education, 42*(3), 255-284.

Ertmer, P. A., & Ottenbreit-Leftwich, A. (2013). Removing obstacles to the pedagogical changes required by Jonassen's vision of authentic technology-enabled learning. *Computers and Education*, *64*, 175–182. https://doi.org/10.1016/j.compedu.2012.10.008

Ertmer, P. A., Ottenbreit-Leftwich, A. T., Sadik, O., Sendurur, E., & Sendurur, P. (2012). Teacher beliefs and technology integration practices: A critical relationship. *Computers and Education, 59*(2), 423-435. https://doi.org/10.1016/j.compedu.2012.02.001

Ertmer, P. A., Ottenbreit-Leftwich, A., & Tondeur, J. (2015). Teacher beliefs and uses of technology to support 21st century teaching and learning. In H. R. Fives & M. Gill (Eds.), *International handbook of research on teacher beliefs* (pp. 403-418). New York: Routledge, Taylor & Francis.

Ertmer, P. A., Ottenbreit-Leftwich, A., & York, C. S. (2006). Exemplary technology-using teachers. *Journal of Computing in Teacher Education, 23*(2), 55-61. https://doi.org/10.1080/10402454.2006.10784561

Farjon, D., Smits, A., & Voogt, J. (2019). Technology integration of pre-service teachers explained by attitudes and beliefs, competency, access, and experience. *Computers and Education*, *130*, 81–93. https://doi.org/10.1016/j.compedu.2018.11.010

Fischer, C. T. (2009). Bracketing in qualitative research: Conceptual and practical matters. *Psychotherapy Research*, *19*(4-5), 583–590. https://doi.org/10.1080/10503300902798375

Fives, H., & Buehl, M. M. (2011). Spring cleaning for the "messy" construct of teachers' beliefs: What are they? Which have been examined? What can they tell us? In K.R. Harris, S. Graham, and T. Urdan (Eds.), *APA educational psychology handbook, Vol 2: Individual differences and cultural and contextual factors* (pp. 471–499). Washington, DC: American Psychological Association. https://doi.org/10.1037/13274-019

Francom, G. M. (2016). Barriers to technology use in large and small school districts. *Journal of Information Technology Education: Research*, *15*, 577–591. Retrieved from http://www.informingscience.org/Publications/3596

Frels, R. K., & Onwuegbuzie, A. J. (2013). Administering quantitative instruments with qualitative interviews: A mixed research approach. *Journal of Counseling & Development, 91,* 184-194.

Garet, M. S., Porter, A. C., Desimone, L., Birman, B. F., & Yoon, K. S. (2001). What makes professional development effective? Results from a national sample of teachers. *American Educational Research Journal, 38*(4), 915-945.

Given, L. M. (2008). *The SAGE encyclopedia of qualitative research methods* (Vols. 1-0). Thousand Oaks, CA: Sage.

Gliem, J. A., & Gliem, R. R. (2003). Calculating, interpreting, and reporting Cronbach's alpha reliability coefficient for Likert-type scales. *Proceedings of the Midwest Research-to-Practice Conference in Adult, Continuing, and Community Education*. Columbus, OH: The Ohio State University.

Gray, L., Thomas, N., and Lewis, L. (2010). *Teachers' use of educational technology in U.S. public schools: 2009 (NCES 2010-040)*. Washington, DC: Institute of Education Sciences, National Center for Education Statistics.

Greenhow, C., Lewin, C., & Staudt Willet, K. B. (2020). The educational response to Covid-19 across two countries: A critical examination of initial digital pedagogy adoption. *Technology, Pedagogy and Education,* 1-19. https://doi.org/10.1080/1475939X.2020.1866654

Greer, D., Rowland, A. L., & Smith, S. J. (2019). Critical considerations for teaching students with disabilities in online environments. *Teaching Exceptional Children*. https://doi.org/10.1177/0040059914528105

Gu, X., Zhu, Y., & Guo, X. (2013). Meeting the "digital natives": Understanding the acceptance of technology in classrooms. *Educational Technology & Society, 16*(1), 392–402.

Hamilton, E. R., Rosenberg, J. M., & Akcaoglu, M. (2016). The substitution augmentation modification redefinition (SAMR) model: A critical review and suggestions for its use. *TechTrends*, *60*(5), 433-441. https://doi.org/10.1007/s11528-016-0091-y

Harper, B., & Milman, N. B. (2016). One-to-one technology in K-12 classrooms: A review of the literature from 2004 through 2014. *Journal of Research on Technology in Education*, *48*(2), 129-142. https://doi.org/10.1080/15391523.2016.1146564

Harris, J., Phillips, M., Koehler, M., & Rosenberg, J. (2017). TPCK/TPACK research and development: Past, present, and future directions. *Australasian Journal of Educational Technology*, *33*(3), i-viii. https://doi.org/10.14742/ajet.3907

Heath, M. K. (2017). Teacher-initiated one-to-one technology initiatives: How teacher self-efficacy and beliefs help overcome barrier thresholds to implementation. *Computers in the Schools*, *34*(1–2), 88–106. https://doi.org/10.1080/07380569.2017.1305879

Hermans, R., Tondeur, J., van Braak, J., & Valcke, M. (2008). The impact of primary school teachers' educational beliefs on the classroom use of computers. *Computers and Education*, *51*(4), 1499–1509. https://doi.org/10.1016/j.compedu.2008.02.001

Herr, K. & Anderson, G. L. (2005). *The action research dissertation.* Thousand Oaks, CA: Sage.

Hew, K. F., & Brush, T. (2007). Integrating technology into K-12 teaching and learning: Current knowledge gaps and recommendations for future research. *Educational Technology Research and Development*, *55*(3), 223–252. https://doi.org/10.1007/s11423-006-9022-5

Hilton, J. T. (2016). A case study of the application of SAMR and TPACK for reflection on technology integration into two social studies classrooms. *The Social Studies*, *107*(2), 68–73. https://doi.org/10.1080/00377996.2015.1124376

Holden, H., & Rada, R. (2011). Understanding the influence of perceived usability and technology self-efficacy on teachers' technology acceptance. *Journal of Research on Technology in Education*, *43*(4), 343–367. https://doi.org/10.1080/15391523.2011.10782576

Hsu, P. S. (2012). Examining the impact of educational technology courses on preservice teachers' development of TPACK. *Teaching Education, 23*(2), 195–213.

Hsu, P. S. (2016). Examining current beliefs, practices and barriers about technology integration: A case study. *TechTrends*, *60*(1), 30–40. https://doi.org/10.1007/s11528-015-0014-3

Inan, F. A., & Lowther, D. L. (2010). Factors affecting technology integration in K-12 classrooms: A path model. *Educational Technology Research and Development*, *58*(2), 137–154. https://doi.org/10.1007/s11423-009-9132-y

International Association for K-12 Online Learning. (2011). The online learning definitions project [PDF file]. Retrieved from http://www.aurora-institute.org/wp-content/uploads/iNACOL_DefinitionsProject.pdf

Johnson, R. B., & Christensen, L. (2017). *Educational research: Quantitative, qualitative, and mixed approaches* (6th ed.). Thousand Oaks, CA: Sage.

Jones, W. M., Smith, S., & Cohen, J. (2017). Preservice teachers' beliefs about using maker activities in formal K-12 educational settings: A multi-institutional study. *Journal of Research on Technology in Education*, *49*(3–4), 134–148. https://doi.org/10.1080/15391523.2017.1318097A

Joo, Y. J., Park, S., & Lim, E. (2018). Factors influencing preservice teachers' intention to use technology: TPACK, teacher self-efficacy, and Technology Acceptance Model. *Educational Technology and Society*, *21*(3), 48–59.

Karsenti, T. (2016). The interactive whiteboard: Uses, benefits, and challenges. A survey of 11,683 students and 1,131 teachers. *Canadian Journal of Learning & Technology, 42*(5), 1-22.

Kennedy, M. M. (2007). Defining a literature. *Educational Researcher, 36*(3), 139-147. doi: 10.3102/0013189£07299197

Kennedy, K., & Archambault, L. (2012). Offering preservice teachers field experiences in K-12 online learning: A national survey of teacher education programs. *Journal of Teacher Education*, *63*(3), 185–200. https://doi.org/10.1177/0022487111433651

Kennedy, K., Cavanaugh, C., & Dawson, K. (2013). Preservice teachers' experience in a virtual school. *American Journal of Distance Education*, *27*(1), 56–67. https://doi.org/10.1080/08923647.2013.756757

Kim, C., Kim, M. K., Lee, C., Spector, J. M., & DeMeester, K. (2013). Teacher beliefs and technology integration. *Teaching and Teacher Education*, *29*(1), 76–85. https://doi.org/10.1016/j.tate.2012.08.005

Kimmons, R., & Hall, C. (2018). How useful are our models? Pre-service and practicing teacher evaluations of technology integration models. *TechTrends*, *62*(1), 29–36. https://doi.org/10.1007/s11528-017-0227-8

Koehler, M., & Mishra, P. (2009). What is technological pedagogical content knowledge (TPACK)? *Contemporary Issues in Technology and Teacher Education, 9*(1), 60-70.

Koh, J. H. L., Chai, C. S., & Tsai, C. C. (2013). Examining practicing teachers' perceptions of technological pedagogical content knowledge (TPACK) pathways: A structural equation modeling approach. *Instructional Science*, *41*(4), 793–809. https://doi.org/10.1007/s11251-012-9249-y

Kopcha, T. J. (2010). A systems-based approach to technology integration using mentoring and communities of practice. *Educational Technology Research and Development*, *58*(2), 175–190. https://doi.org/10.1007/s11423-008-9095-4

Kopcha, T. J. (2012). Teachers' perceptions of the barriers to technology integration and practices with technology under situated professional development. *Computers and Education*, *59*(4), 1109–1121. https://doi.org/10.1016/j.compedu.2012.05.014

Lei, J., & Zhao, Y. (2007). Technology uses and student achievement: A longitudinal study. *Computers and Education, 49*(2), 284-296. https://doi.org/10.1016/j.compedu.2005.06.013

Kopcha, T. J., & Sullivan, H. (2007). Self-presentation bias in surveys of teachers' educational technology practices. *Educational Technology Research and Development, 55*(6), 627-646.

Levin, T., & Wadmany, R. (2006). Teachers' beliefs and practices in technology-based classrooms: A developmental view. *Journal of Research on Technology in Education*, *39*(2), 157–182.

Levin, T., & Wadmany, R. (2008). Teachers' views on factors affecting effective integration of information technology in the classroom: Developmental scenery. *Journal of Technology and Teacher Education*, *16*, 233–263.

Li, K., Li, Y., & Franklin, T. (2016). Preservice teachers' intention to adopt technology in their future classrooms. *Journal of Educational Computing Research*, *54*(7), 946–966. https://doi.org/10.1177/0735633116641694

Liu, S. H. (2011). Factors related to pedagogical beliefs of teachers and technology integration. *Computers and Education*, *56*(4), 1012–1022. https://doi.org/10.1016/j.compedu.2010.12.001

Liu, F., Ritzhaupt, A. D., Dawson, K., & Barron, A. E. (2017). Explaining technology integration in K-12 classrooms: A multilevel path analysis model. *Educational Technology Research and Development*, *65*(4), 795–813. https://doi.org/10.1007/s11423-016-9487-9

Machin, S., McNally, S., & Silva, O. (2007). New technologies in schools: Is there a payoff? *The Economic Journal*, *117*(2234), 1145–1167. https://doi.org/10.1111/j.1468-0297.2007.02070.x

Mack, N., Woodsong, C., Macqueen, K. M., Guest, G., & Namey, E. (2005). *Qualitative research methods: A data collector's field guide*. Research Triangle Park, NC: Family Health International.

Magiera, K., Smith, C., Zigmond, N., & Gebauer, K. (2005). Benefits of co-teaching in secondary mathematics classes. Teaching Exceptional Children, 37(3), 20-24.

Makki, T. W., O'Neal, L. T. J., Cotten, S. R., & Rikard, R. V. (2018). When first-order barriers are high: A comparison of second- and third-order barriers to classroom computing integration. *Computers and Education*, *120*, 90–97. https://doi.org/10.1016/j.compedu.2018.01.005

Mama, M., & Hennessy, S. (2013). Developing a typology of teacher beliefs and practices concerning classroom use of ICT. *Computers & Education, 68*, 380-387. https://doi.org/10.1016/j.compedu.2013.05.022

McCulloch, A. W., Hollebrands, K., Lee, H., Harrison, T., & Mutlu, A. (2018). Factors that influence secondary mathematics teachers' integration of technology in mathematics lessons. *Computers and Education*, *123*, 26–40. https://doi.org/10.1016/j.compedu.2018.04.008

Merriam, S. B. (1998). *Qualitative research and case study application in education*. San Francisco, CA: Jossey-Bass Publications.

Merriam, S. B. & Tisdell, E. J. (2016). *Qualitative research: A guide to design and Implementation* (4th ed.). San Francisco, CA: Jossey-Bass Publications.

Mertens, D. M. (2009). *Research and evaluation in education and psychology: Integrating diversity with quantitative, qualitative, and mixed methods.* Thousand Oaks, CA: Sage.

Mertler, C. A. (2017). *Action research: Improving schools and empowering educators* (5th ed.). Thousand Oaks, CA: Sage.

Michael, S. (1998). Best practices in information technology (IT) management: Insights from K-12 schools' technology audits. *International Journal of Educational Management, 12*(6), 277-288.

Miles, M.B., Huberman, A.M. & Saldaña, J. (2020). *Qualitative Data Analysis: A Methods Sourcebook* (4th ed.). Thousand Oaks, CA: Sage.

Mills, G. E. (2018). *Action research: A guide for the teacher researcher* (6th ed.). New York, NY: Pearson.

Miranda, H. P., & Russell, M. (2012). Understanding factors associated with teacher-directed student use of technology in elementary classrooms: A structural equation modeling approach. *British Journal of Educational Technology*, *43*, 652–666. https://doi.org/10.1111/j.1467-8535.2011.01228.x

Morgan, D. (2014). *Integrating qualitative and quantitative methods: A pragmatic approach.* Thousand Oaks, CA: Sage.

Mueller, J., Wood, E., Willoughby, T., Ross, C., & Specht, J. (2008). Identifying discriminating variables between teachers who fully integrate computers and teachers with limited integration. *Computers and Education*, *51*(4), 1523–1537. https://doi.org/10.1016/j.compedu.2008.02.003

Murphy, E., & Coffin, G. (2003). Synchronous communication in a web-based senior high school course: Maximizing affordances and minimizing constraints of the tool. *American Journal of Distance Education, 17*(4), 235–246. doi:10.1207/s15389286ajde1704_4

Nespor, J. (1987). The role of beliefs in the practice of teaching. *Journal of Curriculum Studies*, *19*(4), 317–328.

Orlando, J. (2013). ICT-mediated practice and constructivist practices: Is this still the best plan for teachers' uses of ICT? *Technology, Pedagogy and Education*, *22*(2), 231–246. https://doi.org/10.1080/1475939X.2013.782702

Ottenbreit-Leftwich, A. T., Glazewski, K. D., Newby, T. J., & Ertmer, P. A. (2010). Teacher value beliefs associated with using technology: Addressing professional and student needs. *Computers and Education, 55*(3), 1321–1335. https://doi.org/10.1016/j.compedu.2010.06.002

Pajares, M. F. (1992). Teachers' beliefs and educational research: Cleaning up a messy construct. *Review of Educational Research*, *62*(3), 307–332. Retrieved from http://www.jstor.org/stable/1170741

Palak, D., & Walls, R. T. (2009). Teachers' beliefs and technology practices: A mixed-methods approach. *Journal of Research on Technology in Education*, *41*(4), 417–441.

Petko, D. (2012). Teachers' pedagogical beliefs and their use of digital media in classrooms: Sharpening the focus of the "will, skill, tool" model and integrating teachers' constructivist orientations. *Computers and Education*, *58*(4), 1351–1359. https://doi.org/10.1016/j.compedu.2011.12.013

Pittman, T., & Gaines, T. (2015). Technology integration in third, fourth and fifth grade classrooms in a Florida school district. *Educational Technology Research and Development*, *63*(4), 539–554. https://doi.org/10.1007/s11423-015-9391-8

Polly, D., & Hannafin, M. J. (2011). Examining how learner-centered professional development influences teachers' espoused and enacted practices. *Journal of Educational Research*, *104*(2), 120–130. https://doi.org/10.1080/00220671003636737

Polly, D., Mims, C., Shepherd, C. E., & Inan, F. (2010). Evidence of impact: Transforming teacher education with Preparing Tomorrow's Teachers to Teach with Technology (PT3) grants. *Teaching and Teacher Education*, *26*(4), 863–870. https://doi.org/10.1016/j.tate.2009.10.024

Polly, D., & Rock, T. (2016). Elementary education teacher candidates' integration of technology in the design of interdisciplinary units. *TechTrends*, *60*(4), 336–343. https://doi.org/10.1007/s11528-016-0059-y

Porras-Hernández, L. H., & Salinas-Amescua, B. (2013). Strengthening TPACK: A broader notion of context and the use of teacher's narratives to reveal knowledge construction. *Journal of Educational Computing Research*, *48*(2), 223–244. https://doi.org/10.2190/ec.48.2.f

Puentedura, R. (2014). Building transformation: An introduction to the SAMR model [Blog post]. Retrieved from http://www.hippasus.com/rrpweblog/archives/2014/08/22/BuildingTransformation_AnIntroductionToSAMR.pdf

Rokeach, M. (1968). *Beliefs, attitudes, and values: A theory of organization and change.* San Francisco: Jossey-Bass.

Roulston, K., & Shelton, S. A. (2015). Reconceptualizing bias in teaching qualitative research methods. *Qualitative Inquiry*, *21*(4), 332–342. https://doi.org/10.1177/1077800414563803

Rudestam, K. E., & Newton, R. R. (2007) *Surviving your dissertation: A comprehensive guide to content and process.* Thousand Oaks, CA: Sage.

Ruggiero, D., & J. Mong, C. (2015). The teacher technology integration experience: Practice and reflection in the classroom. *Journal of Information Technology Education: Research*, *14*, 161–178. https://doi.org/10.28945/2227

Saine, P., & West, J. A. (2017). Content area teacher candidates' self-efficacy beliefs of teaching writing online. *Journal of Digital Learning in Teacher Education*, *33*(2), 69–77. https://doi.org/10.1080/21532974.2017.1280433

Sadaf, A., & Johnson, B. L. (2017). Teachers' beliefs about integrating digital literacy into classroom practice: An investigation based on the Theory of Planned Behavior. *Journal of Digital Learning in Teacher Education*, *33*(4), 129–137. https://doi.org/10.1080/21532974.2017.1347534

Sadaf, A., Newby, T. J., & Ertmer, P. A. (2012). Exploring pre-service teachers' beliefs about using Web 2.0 technologies in K-12 classroom. *Computers and Education*, *59*(3), 937–945. https://doi.org/10.1016/j.compedu.2012.04.001

Scherer, R., & Teo, T. (2019). Unpacking teachers' intentions to integrate technology: A meta-analysis. *Educational Research Review, 27,* 90-109. https://doi.org/10.1016/j.edurev.2019.03.001

Scruggs, T. E., Mastropieri, M. A., & McDuffie, K. A. (2007). Co-teaching in inclusive classrooms: A metasynthesis of qualitative research. *Exception Children, 73*(4), 392-416.

Shenton, A. K. (2004). Strategies for ensuring trustworthiness in qualitative research projects. *Education for Information*, *22*(2), 63-75.

Shifflet, R., & Weilbacher, G. (2015). Teacher beliefs and their influence on technology use: A case study. *Contemporary Issues in Technology & Teacher Education*, *15*(3), 1–50. https://doi.org/10.1109/IEMBS.2010.5627465

Shulman, L. S. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher, 15*(2), 4-14.

Smith, S. J., Basham, J., Rice, M. F., & Carter, R. A. (2016). Preparing special educators for the K–12 online learning environment: A survey of teacher educators. *Journal of Special Education Technology*, *31*(3), 170–178. https://doi.org/10.1177/0162643416660834

Taimalu, M., & Luik, P. (2019). The impact of beliefs and knowledge on the integration of technology among teacher educators: A path analysis. *Teaching and Teacher Education*, *79*, 101–110. https://doi.org/10.1016/j.tate.2018.12.012

Tamin, R. M., Bernard, R. M., Borokhovski, E., Abrami, P. C., & Schmid, R. F. (2011). What forty years of research says about the impact of technology on learning. *Review of Educational Research*, *81*(1), 4–28. https://doi.org/10.3102/0034654310393361

Taylor, S., & Todd, P. A. (1995). Understanding information technology usage: A test of competing models. *Information Systems Research*, *6*(2), 144–176. https://doi.org/10.1287/isre.6.2.144

Tondeur, J., Aesaert, K., Prestridge, S., & Consuegra, E. (2018). A multilevel analysis of what matters in the training of pre-service teacher's ICT competencies. *Computers & Education*, *122*, 32–42. https://doi-org.pallas2.tcl.sc.edu/10.1016/j.compedu.2018.03.002

Tondeur, J., van Braak, J., Ertmer, P. A., & Ottenbreit-Leftwich, A. (2017). Understanding the relationship between teachers' pedagogical beliefs and technology use in education: A systematic review of qualitative evidence. *Educational Technology Research and Development*, *65*(3), 555–575. https://doi.org/10.1007/s11423-016-9481-2

U.S. Department of Education. (2016). *Number and internet access of instructional computers and rooms in public schools, by selected school characteristics: Selected years, 1995 through 2008.* Washington, DC: Institute of Education Sciences, National Center for Education Statistics.

U.S. Department of Education. (2017). *Reimagining the role of technology in education: 2017 National Technology Plan update*. Washington, DC: U.S. Department of Education.

van Braak, J., Tondeur, J., & Valcke, M. (2004). Explaining different types of computer use among primary school teachers. *European Journal of Psychology of Education*, *19*(4), 407–422. https://doi.org/10.1007/BF03173218

Vannatta, R. A., & Fordham, N. (2004). Teacher dispositions as predictors of classroom technology use. *Journal of Research on Technology in Education*, *36*(3), 253–271.

Vareberg, K., & Platt, C. A. (2018). Little tech on the prairie: Understanding teachers' adoption of and resistance to technology in the rural classroom. *Journal of the Communication, Speech & Theatre Association of North Dakota*, *31*, 27–42.

Vongkulluksn, V. W., Xie, K., & Bowman, M. A. (2018). The role of value on teachers' internalization of external barriers and externalization of personal beliefs for classroom technology integration. *Computers and Education*, *118*, 70–81. https://doi.org/10.1016/j.compedu.2017.11.009

Wachira, P., & Keengwe, J. (2010). Technology integration barriers: Urban school mathematics teachers' perspectives. *Journal of Science Education and Technology, 20*(1), 17–25. https://doi.org/10.1007/s10956-010-9230-y

Walker, L. R., & Shepard, M. (2011). Phenomenological investigation of elementary school teachers who successfully integrated instructional technology into the curriculum. *Journal of Educational Research and Practice*, *1*(1), 23–35. https://doi.org/10.5590/JERAP.2011.01.01.02

Wang, L., Ertmer, P. A., & Newby, T. J. (2004). Increasing preservice teachers' self-efficacy beliefs for technology integration. *Journal of Research on Technology in Education*, *36*(3), 231–250. https://doi.org/10.1080/15391523.2004.10782414

Yazan, B. (2015). Three approaches to case study methods in education: Yin, Merriam, and Stake. *The Qualitative Report, 20*(2), 134-152.

APPENDIX A

IRB APPROVAL

UNIVERSITY OF SOUTH CAROLINA

OFFICE OF RESEARCH COMPLIANCE

INSTITUTIONAL REVIEW BOARD FOR HUMAN RESEARCH
APPROVAL LETTER for EXEMPT REVIEW

Holli Bice
Wardlaw College 130
Columbia, SC 29208 USA
Re: Pro00095253

Dear Mrs. Holli Bice:

This is to certify that the research study **Teachers' Beliefs, Barriers, and Classroom Practices: A Mixed Methods Study of Technology Integration at** was reviewed in accordance with 45 CFR 46.104(d)(2) and 45 CFR 46.111(a)(7), the study received an exemption from Human Research Subject Regulations on **1/23/2020**. No further action or Institutional Review Board (IRB) oversight is required, as long as the study remains the same. However, the Principal Investigator must inform the Office of Research Compliance of any changes in procedures involving human subjects. Changes to the current research study could result in a reclassification of the study and further review by the IRB.

Because this study was determined to be exempt from further IRB oversight, consent document(s), if applicable, are not stamped with an expiration date.

All research related records are to be retained for at least three (3) years after termination of the study.

The Office of Research Compliance is an administrative office that supports the University of South Carolina Institutional Review Board (USC IRB). If you have questions, contact Lisa Johnson at lisaj@mailbox.sc.edu or (803) 777-6670.

Sincerely,

Lisa M. Johnson
ORC Assistant Director and IRB Manager

APPENDIX B

SCHOOL BUILDING APPROVAL

Holli Bice

Approval to conduct research
2 messages

Holli Bice Sat, Nov 16, 2019 at 1:45 PM
To: Joshua Clark

Good afternoon, Josh,

I am writing to seek your permission to conduct research at . The purpose of my research study will be to describe teachers' experiences with technology integration at the school. Specifically, I am interested in teachers' beliefs about the role of technology in instruction and their perceived barriers to integration. My study will follow a mixed methods research design. The quantitative phase will consist of an online survey sent to all faculty collecting information about their attitudes toward technology and experiences using technology for teaching and learning. Survey results will provide a general description of how technology is being used by teachers at the school. From the survey responses, four teachers will be selected to participate in the qualitative phase, two teachers who are experienced technology integrators and two teachers who are novice technology integrators. The qualitative phase will consist of two interviews and three classroom observations of each teacher with the goal being to understand how teachers' beliefs vary between these discrepant cases and to identify barriers that exist to integration. The study is expected to take 15 weeks with data collection beginning spring semester 2020. Please let me know if you have questions about my research or would like additional information.

Thank you in advance for your consideration.
Best,

Holli Bice, Ed.S.
Curriculum and Instruction Technology Coordinator
Associate - AOGPE
Apple Teacher

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Build a solid educational foundation for students with dyslexia and develop their rich potential.

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Joshua Clark Sun, Nov 17, 2019 at 4:26 PM
To: Holli Bice <

Thank you for this request, Holli. You have my full permission to proceed, and The is excited to take part in this project.
[Quoted text hidden]
--

Josh J. Clark

Head of School

1/2

APPENDIX C

ADAPTED SURVEY OF TECHNOLOGY INTEGRATION AND RELATED FACTORS

Section 1: Demographic Data

1. What grade level do you teach? Kindergarten, 1st, 2nd, 3rd, 4th, 5th, 6th
2. What subject area(s) do you teach? Phonics, math, writing, science, social studies, specials
3. What is the highest level of education you have obtained? Bachelor's, Master's, Specialist, Doctorate
4. How many years have you been teaching?
5. How many years have been teaching at the school?
6. What is your age?

Section 2: Technology Access and Support

For items 7–13, choose the answer that best describes the following technology availability/access at your school:

1 = poor, 2 = fair, 3 = adequate, 4 = good, 5 = excellent

7. The technological hardware available to my students and me for instruction
8. The software available to my students and me at my school
9. The speed of the available internet connection at my school
10. The reliability of the internet connection at my school
11. The professional development opportunities related to technology that my school makes available to you
12. The technical support (e.g., troubleshooting) that is available to me
13. The instructional technology support that is available to me

Section 3: The Importance of Technology in Teaching and Learning

For the items 14–32, choose the answer that best reflects your agreement or disagreement:

1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree

14. Technology should be incorporated into the classroom curriculum.
15. Technology makes my job as a teacher easier.
16. Incorporating technology into lessons enhances my instruction.
17. Using diverse technology (i.e., software, hardware) enriches the repertoire of learning activities in my lessons.
18. Integrating technology into my instruction successfully increases my motivation to teach.

19. Knowledge about technology will improve my teaching.
20. Technology helps me do things with my classes that I would not be able to do without it.
21. The technology tools I use in lessons depend on the content I am teaching.
22. Technology facilitates my classroom operations and organization.
23. Technology skills are essential for my students' success.
24. Technology helps equip students with technology skills for future use.
25. Using technology increases the motivation of students.
26. Technology increases student engagement and collaboration.
27. Students' use of technology in the classroom is important for knowledge construction.
28. Using technology with students increases their learning.
29. A variety of technologies are important for student learning.
30. Using technology makes learning more meaningful and relevant for students.
31. Using technology improves student comprehension and promotes higher-level thinking.
32. Technology can supplement student learning.

Section 4: Technology Use by Students
For items 33–40, how often do your students use the following technologies for school related activities?

1 = not at all, 2 = once per month or less, 3 = once per week,
4 = several times per week, 5 = daily

33. Word processors (typing)
34. Internet research
35. Drill and practice/Learning games/Tutorial
36. Presentation software (Google Slides, Powerpoint, etc.)
37. Online collaboration tools (Google Drive, Google Hangouts, Skype, Padlet, Flipgrid, etc.)
38. Graphics programs (draw/paint, photo editing, video, etc.)
39. Please list other technologies your students use on a regular basis.
40. Generally speaking, how would you describe your students' level of technology usage for classroom-related activities?

    1 = nonexistent, 2 = limited, 3 = average, 4 = above average, 5 = excellent

Section 5: Technology Use by Teachers
For items 41–49, how often do you use the following technologies for school-related activities?

1 = not at all, 2 = once per month or less, 3 = once per week,
4 = several times per week, 5 = daily

41. Internet research for planning and ideas
42. Organization/tracking software for classroom management
43. Communication with parents/students (email, blog, text, etc.)
44. Presentations during instruction (Google Slides, PowerPoint, etc.)
45. Multimedia enhancements during instruction (videos, simulations, etc.)
46. Website creation or maintenance (e.g. class website)

47. Providing individualized or remedial instruction
48. Please list other technologies.
49. Generally speaking, how would you describe your level of technology integration for instruction?
    1 = nonexistent, 2 = limited, 3 = average, 4 = above average, 5 = excellent

Section 6: Barriers to Technology Integration

For the items 50–66, choose the answer that best reflects your agreement or disagreement:

1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree

50. Developing lesson plans that incorporate technology takes too much of my time.
51. Learning to use technology for instruction is time-consuming.
52. Teaching students how to use technology take much of classroom time.
53. There is a lack of available computers/hardware.
54. There is a lack of professional development opportunities related to technology use.
55. I do not have enough mentoring to help me increase my knowledge about technology.
56. The technology-related professional development that is provided does not apply to my learning environment.
57. There is a lack of administrative encouragement/support.
58. There is a lack of IT personnel to help with technology issues.
59. I lack knowledge about technology.
60. I lack knowledge about ways to integrate technology into the curriculum.
61. There is too much material to cover.
62. I do not see a need to use technology for learning when my traditional classroom practices continue to work.
63. Technology is not essential to teaching and learning.
64. Teaching students content knowledge should take priority over teaching them technology skills.
65. Technology-based activities use more class time than traditional methods of instruction.
66. Most students have so many other needs that technology use is a low priority.

APPENDIX D

INTIAL INTERVIEW PROTOCOL

Good afternoon! Thank you so much for sitting down with me. Let me tell you a little bit about this research study before we begin. I am a student at the University of South Carolina getting my doctorate in Curriculum and Instruction. As part of my degree requirements, I am conducting an action research project at our school. Specifically, I am interested in learning about our teachers' experiences integrating technology. Participation in this study is voluntary, and you may withdraw at any time without negative consequences. You may also stop this interview at any time if you do not wish to proceed. In addition to this interview, I will be conducting three classroom observations and a second interview. To thank you for your time and participation, I will be giving each participant a $50 Visa gift card. Are you willing to participate?

I would like to record our conversation in order to transcribe our conversation later. Do I have your permission to record this interview using GarageBand? Our interview should last about one hour, and during that time I will ask you some questions about your beliefs and experiences regarding technology use in the classroom. There are no right or wrong answers to these questions. I also have a few demographic questions to ask you in order to better describe the sample in my study. In addition to recording this interview, I will be taking notes to ensure accuracy when transcribing. This interview will only be used for research purposes, and your confidentiality will be maintained. You will have an opportunity to review information from this interview after it is transcribed. Do you have questions before we begin? (Answer questions as needed). Great! Let's begin.

1. What is your age?
2. What is your level of education?
3. How many years have you been teaching?
    a. How many of those years have been at the school?
4. How has technology in the classroom changed since you've been teaching?
5. In your opinion, what is the role of technology in teaching?
    a. In what ways does technology help you as a teacher?
    b. Can you give a specific example?
6. How would you describe the role of technology in learning?
    a. In what ways does technology help students?
    b. Can you give a specific example?
7. What do you think are some benefits to using technology in your classroom?
    a. What are some disadvantages to using technology in your classroom?
8. What are your pedagogical beliefs driving your classroom practices?
    a. How does technology fit with your pedagogical beliefs?

9. What are some technology tools you use in your classroom?
    a. Describe the ways in which you use these tools.
    b. How do these tools support what you are teaching?
    c. How do they support student learning?
10. Which technology tool do you use the most in your classroom?
    a. How frequently do you use that tool?
    b. Why do you use that tool more than others?
    c. Give an example of how you use that tool in a lesson.
11. How would you describe effective technology integration?
    a. What knowledge and skills are necessary for technology integration to be effective?
    b. Describe a time when you felt successful integrating technology in your classroom.
    c. Describe a time when you felt you were unsuccessful integrating technology in your classroom.
12. Has the integration of technology changed your teaching?
    a. If so, describe how it has changed your teaching?
    b. If not, why do you think it has not changed your teaching?
13. What factors motivate you to use technology?
    a. Do you feel pressure from peers and/or administrators to use technology in your classroom? If so, how much does this affect your decision?
    b. To what extent do you consider how easy a technology tool is to use when deciding to implement?
14. What barriers have prevented you from using technology in your classroom?
    a. Can you describe a time you were not able to use technology because of ____?
        i. Resources (technology, time, technical support)
        ii. Knowledge and skills (specific technology knowledge and skills, students' technology knowledge and skills, technology-related classroom management knowledge and skills)
        iii. Beliefs (teachers' beliefs and attitudes about technology)
        iv. Institution (administration, parents, community)
        v. Assessments
        vi. Professional development
        vii. Subject culture
15. What do you think you need to integrate technology more in your classroom?
16. Is there anything you would like to add about technology integration or how you use technology in your classroom?

Thank you so much for taking the time to meet with me today. Your cooperation has been very helpful to my research. As I mentioned earlier, I will be in touch with you in the near future to provide an opportunity for you to review information from this interview. Do you have any questions for me before we end the interview?

APPENDIX E

SECOND AND THIRD INTERVIEW PROTOCOL

Good afternoon! Thank you so much for meeting with me again. Our interview should last about 30 to 45 minutes, and during that time I would like to ask you some general questions about your use of technology and some specific questions I have relating to lessons I observed. I would like to record our conversation in order to transcribe our conversation later. Do I have your permission to record our interview using GarageBand? In addition to recording this interview, I will be taking notes to ensure accuracy when transcribing. You may stop this interview at any time if you do not wish to continue. This interview will only be used for research purposes, and your confidentiality will be maintained. You will have an opportunity to review information from this interview after it is transcribed. Do you have questions before we begin? (Answer questions as needed). Great! Let's begin.

1. I enjoyed observing your lessons. In your opinion, how did the lesson I observed represent your typical technology use for your classroom during distance learning?
2. Can you tell me a little about your lesson planning process for that specific lesson?
3. What factors do you consider when you are planning to integrate technology in your classroom?
    a. What is your starting point for deciding to use a technology tool (e.g., state standards, learning goals, ease of use, or anything else)?
4. What do you perceive the role of technology to be in distance learning?
5. How has the distance learning environment affected your integration of technology?
6. In the lesson I observed, you used _________. Can you explain why you selected that technology tool?
    a. How did that tool help your instruction?
    b. How did it influence student learning in that activity?
    c. How frequently do you use that tool?
    d. Did you use this tool previously?
    e. Are there other ways you have used that tool for teaching or learning? Can you describe them.
7. In the lesson I observed, you assigned _________.
    a. How did it influence student learning in that activity?
    b. How frequently do you give assignments that require that tool?
    c. Are there other ways you have used that tool for teaching or learning? Can you describe them.

8. How does your technology use in the lessons I observed align with your pedagogical beliefs?
    a. Can you give a specific example illustrating how your beliefs are enacted in your practice?
9. In our initial interview, I asked you about barriers you had encountered to integrating technology. I want you to think about barriers you have encountered in this distance learning environment. What barriers have prevented you from using technology in your classroom?
    a. Can you think of or describe a time you were not able to use technology because devices weren't available?
    b. Can you think of or describe a time you were not able to use technology because you didn't have time?
    c. Can you think of or describe a time you were not able to use technology because you lacked technical support?
    d. Can you think of or describe a time you were not able to use technology because you lacked specific technology knowledge and skills?
    e. Can you think of or describe a time you were not able to use technology because students lacked technology knowledge and skills?
    f. Can you think of or describe a time you were not able to use technology because you lacked technology-related classroom management knowledge and skills?
    g. Can you think of or describe a time you were not able to use technology because your beliefs and attitudes about technology prevented you?
    h. Can you think of or describe a time you were not able to use technology because other teachers' beliefs and attitudes about technology prevented you?
    i. Can you think of or describe a time you were not able to use technology because administration, parents, or the school community prevented you?
10. What do you think you need to integrate technology more in your distance learning classroom?
11. Is there anything you would like to add about technology integration?

Thank you so much for taking the time to meet with me today. Your cooperation has been very helpful to my research. As I mentioned earlier, I will be in touch with you in the near future to provide an opportunity for you to review information from this interview. Do you have any questions for me before we end the interview

APPENDIX F

TECHNOLOGY INTEGRATION CLASSROOM OBSERVATION PROTOCOL

Date: ____________________

Teacher: ___________________________ Subject/Grade: _______________________

Observation start time: ________________ Observation end time: _________________

Setting		
Variable	**Data**	**Notes**
Number of students		
Number/type of devices		
Layout of room		

Groups		
Variable	**✓ all that apply**	**Notes**
Individual		
Pairs/Small Groups		
Whole Class		

Teacher Activity		
Variable	**✓ all that apply**	**Notes**

Lecturing		
Facilitating/Coaching		
Modeling		
Individualized Instruction		
Assessing		

Student Engagement	
Rating	**Notes**
High	
Medium	
Low	

Technology Activities				
Variable	**Teacher**	**Comments**	**Student**	**Comments**
Displaying Information				
Word Processing				
Drill and Practice				
Video				
Note-taking				
Recitation/ Fluency				

Brainstorm				
Assessment				
Research				
Student Discussion				
Simulation				
Product Creation				
Project-based Activities				

Technology Tools Used				
Variable	**Teacher**	**Comment**	**Student**	**Comment**
Interactive Display				
Laptop				
iPad				
Calculator				
Document Camera				
Presentation Software				
Notebook Software				
Web Browser				
Assessment Software				
Assistive Technology				
Thinking Tools				

Audio/Video Editing Tools				
Productivity Software				
Collaborative Software				
Subject-specific Software				

Descriptions	
Term	**Description/Definition**
Displaying Information	Information is displayed to assist instruction through the use of technology, such as an interactive display, projector, or document camera.
Word Processing	Text is produced on a computer. Tasks that might involve word processing include writing a report or summarizing information.
Drill and Practice	Systematic instruction involving the repetition of concepts to aid learning. Drill and practice might be used for phonics decks, math facts, and vocabulary terms.
Video	Watching a video.
Note-taking	Recording notes related to content through the use of technology.
Recitation/ Fluency	Repeated readings of the same text for the purpose of improving fluency. Readings may be recorded for analysis and review.
Brainstorm	Producing ideas or topics for the purpose of writing, discussion, or problem-solving. May be a group or independent activity.
Assessment	Gathering data about learning.
Research	The systematic collecting of information.
Student Discussion	Conversation between two or more students focused around a topic.
Simulation	Modeling a process or situation through the use of a digital app or web-based application.

Product Creation	The creation of a tangible product using various methods and tools.
Project-based Activities	Activities centered around a project-based learning unit.
Interactive Display	A digital surface than can function as a touch screen when a computer is connected to it.
Laptop	A mobile, general-purpose computer.
iPad	A mobile device with a touch screen created by Apple.
Calculator	A handheld device or application on an iPad or laptop that is used for computation.
Document Camera	A digital-imaging device that projects real-time images onto a whiteboard, wall, or other display surface for presentation.
Presentation Software	Software used to create multimedia presentations (e.g., Google Slides, PowerPoint, Keynote).
Notebook Software	Proprietary software created for Smart Interactive Displays (SID) that allows interaction with the SID.
Web Browser	Software allowing access to the Internet (e.g., Safari, Google Chrome)
Assessment Software	Software used to assess learning, may be web-based or digital application (e.g., Kahoot, Socrative, Quizzez).
Assistive Technology	Technology used by students with a disability (e.g., text to speech, voice recognition, audiobooks).
Thinking Tools	Technology tools used to organize information, such as through Venn diagrams, word webs, and outlines (e.g., Inspiration, Popplet).
Audio/Video editing tools	Technology tools used to edit audio and/or video tracks (e.g., GarageBand, iMovie).
Productivity Software	Software used for producing information (e.g., databases, word processing, spreadsheets).
Collaborative Software	Software that allows more than one editor to contribute to a web page, discussion thread, document, or other shared file at the same time (e.g., blogs, discussion boards, Padlet).
Subject-specific Software	Specialized software designed to aid instruction relating to a specific content areas.

Student Engagement Ratings	
High	70% or more of the students in the class are actively participating in learning activities (discussions, listening to the teacher, looking at the course material, etc.).
Medium	30% to 69% of students in the class are actively participating in learning activities (discussions, listening to the teacher, looking at the course material, etc.).
Low	Less than 30% of students in the class are actively participating in learning activities (discussions, listening to the teacher, looking at the course material, etc.).

APPENDIX G

ONLINE SURVEY INVITATION TO PARTICPATE

You are invited to participate in a web-based online survey about your experiences with technology as a teacher at [the name of the school]. This research study is being conducted by Holli Bice, a doctoral candidate at the University of South Carolina. This research fulfills part of the degree requirements for a doctorate in Curriculum and Instruction.

This research study examines technology integration at [the name of the school]. If you decide to participate in this survey, you will be asked questions about your experiences integrating technology into your classroom. In particular, you will be asked about the role of technology in teaching and learning, how you use technology, how your students use technology, and what barriers you have encountered when integrating technology. The survey contains 66 items and should take about 15 minutes to complete.

Your participation in this survey is completely voluntary. If you decide not to participate there will not be any negative consequences. Please be aware that if you decide to participate, you may stop participating at any time and you may decide not to answer any specific question.

Participation is confidential. Study information will be kept in a password protected file on the researcher's computer. The results of the study may be published or presented at professional meetings, but your identity will not be revealed.

Questions about the study can be directed to Holli Bice, phone: or email: You may also contact the faculty advisor overseeing this research, Dr. Hengtao Tang, phone: (803) 777-7257 or email: htang@mailbox.sc.edu. If you have questions about your rights as a research subject, you may the University of South Carolina's Office of Research Compliance by phone: (803) 777-6670.

Thank you for your consideration. To participate, select "yes" below to continue to the survey.

APPENDIX H

INTERVIEW/OBSERVATION INVITATION TO PARTICIPATE

Dear Prospective Participant,

My name is Holli Bice, and I am a doctoral candidate in the Department of Curriculum and Instruction, at the University of South Carolina. I am conducting a research study as part of the requirements of my degree in Educational Technology, and I would like to invite you to participate.

The purpose of this study is to describe teachers' experiences with technology integration at [the name of the school]. You are being asked to participate in this study because you are a faculty member at the school. If you decide to participate, you will be asked to meet with me for two interviews to discuss your experiences integrating technology into your classroom and allow me to observe you teaching. In particular, you will be asked questions about your beliefs regarding the role of technology in teaching and learning, how you use technology for teaching and learning, and what barriers you have encountered when integrating technology. Interviews will take place at a mutually agreed upon time and place and should last about 60 minutes for the first interview and 30 minutes for the second interview. Classroom observations will occur twice at agreed upon times and last the length of your class. The interviews will be audiotaped so I can accurately describe what is discussed. The audio files will only be reviewed by members of the research team and destroyed upon completion of the study.

Participation in this research study is confidential. Study information will be kept in a password protected file on my computer. The results of the study may be published or presented at professional meetings, but your identity will not be revealed.

You will receive a Visa $50 gift card for participating in the study.

We will be happy to answer any questions you have about the study. You may contact me by phone: or email: . You may also contact my faculty advisor, Dr. Hengtao Tang, phone: (803) 777-7257 or email: htang@mailbox.sc.edu. If you have questions about your rights as a research subject, please contact the University of South Carolina's Office of Research Compliance at (803) 777-6670.

Thank you for your consideration. If you would like to participate, please contact me via the email listed below to discuss participating.

With kind regards,

Holli Bice